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ABSTRACT

This handbook is the fourth in a series of five competency-based resource guides on microcomputer applications for vocational teachers. The six units of instruction in this handbook are concerned with the content of the seven competencies included in the category, "Planning and Organizing the Vocational Education Learning Environment for Competency-Based Instruction." Units are designed to prepare teachers to do the following: (1) develop a plan to implement competency-based instruction (CBI) in the vocational learning environment, (2) project resource needs for CBI, (3) provide microcomputer maintenance, (4) establish microcomputer user data security, (5) establish microcomputer hardware/software security, and (6) create authorized backup copies of microcomputer software. Components of each unit include unit and specific objectives, informative material, sample forms and evaluation measures, examples, a summary, achievement indicators, and a list of references. (YLB)

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# Planning and Organizing the Vocational Education Learning Environment for Competency-Based Instruction

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Adult,
Vocational and
Technical Education

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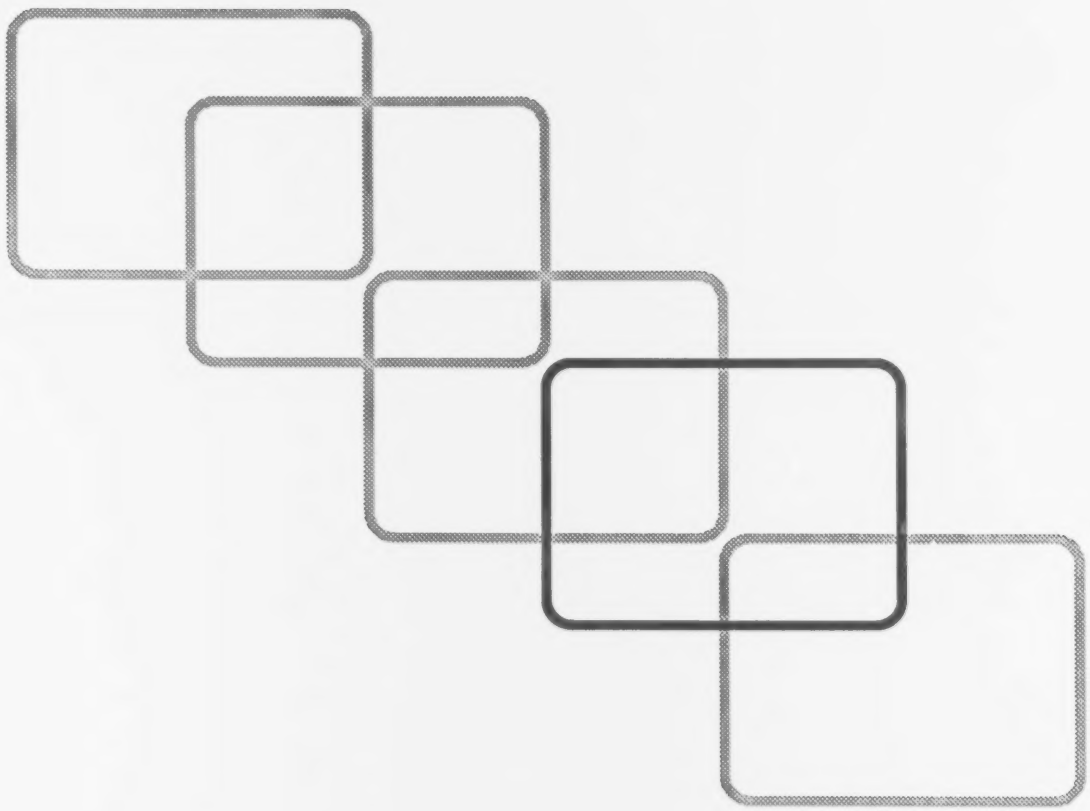

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**Planning and Organizing the Vocational Education Learning Environment for Competency-Based Instruction**

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The foundation for this handbook was laid by a panel of Illinois vocational educators. Individuals were selected to serve on this panel on the basis of demonstrated leadership in the use of microcomputers. Utilizing a structured process known as DACUM (Develop A Curriculum), this group developed the initial competency list for the handbook and field tested the product. The DACUM participants included:

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## INTRODUCTION

# Microcomputer Applications For Vocational Teachers: A Competency-Based Approach

BY:
DR. GENE L. ROTH
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Historically, vocational educators have had to cope with the problem of keeping pace with technology. Preparing students for a workplace that is continually changing is a constant reminder to vocational instructors that they do not have the luxury of resting on previously learned work skills and knowledge. Vocational educators must keep abreast of contemporary developments within their vocational area of expertise.

This concern for technical updating is not limited to industrial or business applications of technology. In addition to concerns about preparing students for a changing world of work, vocational teachers must contend with applications of new instructional technologies. Many vocational teachers are currently struggling with how to integrate computer-based instruction into their classrooms and laboratories.

The rapid influx of microcomputers into vocational classrooms and laboratories has caught many vocational educators unprepared to effectively utilize this contemporary instructional technology. As educational systems continue to acquire computer technology, many vocational instructors are saying, or at least thinking, "Where do we start with these machines?" Microcomputers are often purchased for vocational programs which are staffed by personnel that have not been appropriately trained in the technology. Their knowledge of hardware and software may be quite limited. A resulting danger is that microcomputers will be misused or not used at all because vocational teachers have been inadequately acquainted with educational computing (Pratscher, 1983).

This concern about providing vocational educators with pertinent information related to microcomputer applications has brought about a collaborative effort between two state offices of vocational education. The Illinois State Board of Vocational Education, Department of Adult, Vocational, and Technical Education and the Idaho State Board of Education, Division of Vocational Education are jointly supporting this research and development project entitled "Microcomputer Applications for Vocational Teachers: A Competency-Based Approach." This project, which has been conducted at Idaho State University, features a systematic approach to the identification of microcomputer competencies for vocational instructors (Roth & Tesolowski, in press).

This is a shortened version of an article that appeared in *The Computing Teacher*, 12 (3), November 1984. Reprinted with permission.

# The DACUM Process: A Method for Identifying Microcomputer Competencies

The DACUM (Developing A Curriculum) process (Adams, 1975) was utilized by this project as a foundation in the development of competency-based materials on microcomputer applications for vocational instructors (Roth, Tesolowski, Rankin, & Blackman, 1984). This procedure is based on three assumptions: (a) expert workers can define and describe their jobs more accurately than anyone else; (b) any job can be effectively described in terms of the tasks that successful workers in that occupation perform; and (c) all tasks, in order to be performed correctly, demand certain knowledge and attitudes from workers (Miller-Beach, 1980).

Utilization of the DACUM process required the project to assemble a panel of 12 vocational educators. The 12 members, all from Illinois, included 4 secondary vocational instructors, 4 post-secondary vocational instructors, 3 secondary vocational administrators, and 1 representative of the Department of Adult, Vocational, and Technical Education. In addition to being practitioners in the field of vocational education, these individuals have been recognized as leaders in the state of Illinois at applying microcomputers in their work. The challenge for the DACUM panel was to identify competencies specific to the application of microcomputers in vocational education. This was accomplished through a process of competency identification and consensus decision-making. The activity involved the panelists and the facilitator in two days of difficult work. However, the panelists were rewarded for their efforts as competencies were established for each category and the final profile of microcomputer applications for vocational educators unfolded. Furthermore, the panelists began to realize that they had increased their own personal level of knowledge about the application of microcomputers in vocational education.

## RESULTS OF THE DACUM PROCEDURE

Most vocational teachers recognize the vast potential of microcomputers in vocational education. However, many professionals have had difficulty identifying the precise role of the machine in their professional lives. The DACUM profile provides teachers with a graphic portrayal of how the microcomputer integrates with the overall schema of vocational instruction and curricula. The profile consists of 47 competencies clustered within the following 5 categories (Table 1):

A. Developing a personal plan for microcomputer competency.
B. Integrating computer-based instruction (CBI) into vocational curricula.
C. Planning, executing, and evaluating CBI.
D. Planning and organizing vocational education learning environments for CBI.
E. Performing classroom management functions with CBI.

The content of these 47 competency statements was refined and validated through a formative process. After the DACUM panel had generated the core of this profile, the competency statements were scrutinized and revised by: (a) members of the project team at Idaho State University; (b) a group of vocational educators in Idaho; (c) consultants of the Illinois Department of Adult, Vocational, and Technical Education; and (d) supervisors and staff members of the Idaho Division of Vocational Education.

A survey was conducted by this project's research team to ascertain the relative importance of each of the 47 microcomputer competencies. The survey population consisted of a national sample of 134 vocational educators. These instructors were identified by their respective state supervisors as leaders in their states at applying microcomputers to the roles and responsibilities of their teaching jobs. Ninety-seven vocational teachers (72%) responded to the survey.

Ratings for each competency are listed on the *Vocational Teacher Competency Profile for Microcomputer Applications* (Table 1). Mean ($\bar{x}$) competency ratings were derived from respondents' ratings on the following scale: (1) no importance, (2) minimal importance, (3) average importance, (4) high importance, and (5) extreme importance. Vocational teachers can consider these ratings as benchmarks as to how their peers view microcomputers in vocational teaching.

Instructional units have been packaged in this competency-based resource guide on microcomputer applications for vocational teachers. This handbook is being disseminated by the Curriculum Publications Clearinghouse, Western Illinois University, Macomb, IL 61455.

# VOCATIONAL TEACHER COMPETENCY PROFILE FOR MICROCOMPUTER APPLICATIONS


**Illinois State Board of Education**
**Department of Adult, Vocational and Technical Education**

**Idaho State Board of Vocational Education**
**Division of Vocational Education**

**Dr. Gene L. Roth**
**Project Director**

**Dr. Dennis G. Tesolowski**
**Dr. Roger A. Rankin**
**Dr. Harold S. Blackman**


**Competencies** →

| Category | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **A** **Developing a Personal Plan for Microcomputer Competency** | A.1 Define Elements of a Local Education Agency (LEA) Plan for Computer Based Instruction (CBI) 3.67 | A.2 Define the Vocational Instructor's Role in the LEA Plan for CBI 4.00 | A.3 Conduct a Personal Assessment of Microcomputer Competency 3.90 | A.4 Set Personal Goals for Microcomputer Competency 4.11 | A.5 Construct a Personal Plan for Microcomputer Competency 4.06 | A.6 Implement a Personal Plan for Microcomputer Competency 4.16 | A.7 Evaluate Personal Plan Based on Computer Innovations 3.87 | A.8 Modify Personal Plan as Needed 3.97 |
| **B** **Integrating CBI into Vocational Curricula** | B.1 Identify Job-Specific Applications of Microcomputers for Inclusion in Vocational Curricula 4.42 | B.2 Identify Educational Applications of Microcomputers for Inclusion in Vocational Curricula 4.37 | B.3 Develop a Plan to Apply CBI to Vocational Curricula 4.38 | B.4 Demonstrate an Awareness of Microcomputer Software for Developing Computer Based Vocational Curricula 4.22 | B.5 Write Specifications for Hardware/Software Based on Vocational Curricula Requirements 3.77 | B.6 Implement a Plan to Apply CBI to Vocational Curricula 4.26 | B.7 Evaluate Applications of CBI in Vocational Curricula Based on Innovation in Computer Technology & Work 3.95 | B.8 Modify Applications of CBI in Vocational Curricula as Needed 4.04 |
| **C** **Planning, Executing & Evaluating CBI** | C.1 Differentiate Among Applications of CBI (Such as Drill & Practice, Tutorial, Simulation & Problem Solving) 3.84 | C.2 Assess Students' Needs for Specific CBI Applications 4.15 | C.3 Develop Lesson Plans Incorporating CBI 4.22 | C.4 Select Appropriate Software for Specific Instructional Purposes 4.61 | C.5 Modify Simple Software for Specific Instructional Purposes 3.71 | C.6 Develop Software for Specific Instructional Purposes 3.38 | C.7 Prepare Instructional Materials to Accompany Software 4.22 | C.8 Modify Software Documentation for Specific Instructional Purposes 3.77 |
| **Planning, Executing & Evaluating CBI (Con't)** | C.9 Orient Students to CBI 4.43 | C.10 Execute CBI 4.39 | C.11 Individualize Instruction with CBI 4.17 | C.12 Assess Student Microcomputer Skills 4.02 | C.13 Evaluate Effectiveness of CBI Based on Student Achievement 4.21 | C.14 Modify CBI as Needed 4.10 | | |
| **D** **Planning & Organizing the Vocational Education Learning Environment for CBI** | D.1 Develop a Plan to Implement CBI in Vocational Education Learning Environments 4.11 | D.2 Schedule CBI Activities 3.97 | D.3 Project Resource Needs (Supplies, Materials, Equipment) for CBI 4.02 | D.4 Provide Microcomputer Maintenance 3.69 | D.5 Establish Microcomputer User Security 3.72 | D.6 Establish Microcomputer Hardware/Software Security 3.84 | D.7 Create Authorized Back-up Copies of Microcomputer Software 4.40 | |
| **E** **Performing Classroom Management Functions with CBI** | E.1 Determine Classroom Management Activities to be Performed with CBI 4.13 | E.2 Select Software for Classroom Management Activities 4.28 | E.3 Prepare Software for Classroom Management Activities 3.57 | E.4 Maintain Classroom Rosters 3.44 | E.5 Maintain Attendance Records 3.39 | E.6 Generate Tests 3.83 | E.7 Score Tests 3.53 | E.8 Record Grades or Performance Progress 3.88 |
| **Performing Classroom Management Functions with CBI (Con't)** | E.9 Maintain Inventory of Teaching Supplies, Materials & Equipment 3.91 | E.10 Manage Vocational Student Organizations 3.49 | | | | | | |

**Competency Rating Scale**

The relative importance of these 47 competencies was determined by surveying a national sample of 134 vocational educators. Vocational instructors included in this sample were identified as experts at applying microcomputers in their programs by their respective state supervisors. Ninety-seven (97) vocational teachers (72%) responded to this survey. The following vocational disciplines were represented by this sample: agriculture; business, home economics, marketing and distribution; trade and industrial; and health occupations education. Mean ($\bar{x}$) competency ratings were derived from respondents' ratings based on the following scale:

**1 = No Importance** **2 = Minimal Importance** **3 = Average Importance** **4 = High Importance** **5 = Extreme Importance**

## UTILIZING A "PROFESSIONAL DEVELOPMENT PLAN" TO INTEGRATE MICROCOMPUTERS INTO VOCATIONAL CURRICULA AND INSTRUCTIONAL STRATEGIES

Vocational educators can carefully examine Category A in the profile (Table 1) and begin to envision how the content of the eight competencies included in this category will enable them to develop a personal plan for microcomputer competency (Tesolowski, Wallin, Roth, & Rankin, 1984). Competency A.1 defines the elements and planning strategies involved in developing a comprehensive plan for implementing computer-based instruction (CBI) in a local education agency (LEA). This instructional unit presents practices that have been implemented in select exemplary programs in the nation. Competency A.2 explores the vocational instructor's role in the plan identified for implementing CBI in the LEA (A.1). Varying practices are reviewed in Unit A.2, which will assist vocational teachers in preparing a microcomputer implementation plan.

The content included in Competency A.3 enables vocational educators to assess their personal levels of microcomputer competency. Self-report test items are included for a representative set of pertinent content areas or domains related to computer literacy. Vocational teachers can identify their strengths and weaknesses on the basis of this self-assessment measure. Upon completing this diagnostic-prescriptive instrument, vocational educators can profile their results on a chart. On the basis of their strengths and weaknesses, vocational instructors can set initial personal goals (Competency A.4) for microcomputer competency.

Competency A.5 facilitates the development of a personal plan for microcomputer competency. Vocational teachers who participate in this unit of instruction are encouraged to develop a Professional Development Plan that includes long-range goals; short-term objectives; and the identification of instructional strategies, methods, techniques, materials, and resources that will facilitate the accomplishment of these goals and objectives. In addition, participants will monitor their timeline in regards to when they initiate and conclude selected learning activities. Finally, vocational teachers will record whether or not they believe they have successfully achieved their goals and objectives. Competencies A.6, A.7, and A.8 assist vocational educators in working through the processes of implementing, evaluating, and modifying their personal plans for microcomputer competency.

After vocational instructors construct their Professional Development Plans for microcomputer competency (A.5), they can implement their plans by fully utilizing all of the units of instruction for the 39 competencies clustered in Categories B, C, D, and E. An alternative to using all of the units of instruction is to selectively choose units based on the needs identified in the personal plans, their district's or school's needs, and their personal interests (Roth, Tesolowski, Rankin, & Blackman, 1984).

## THE NEED FOR A PERSONAL COMMITMENT TO APPLY MICROCOMPUTERS IN VOCATIONAL EDUCATION

Competencies identified for this handbook can serve as an invaluable starting point for vocational instructors who want to integrate microcomputers into their professional future. Vocational educators can visually inspect the categories and respective competencies, examine their own teaching situations, and begin to formulate their own individualized plans for applying microcomputers in their programs as well as in their personal lives.

The stage is now set for vocational educators to decide where and how microcomputers will fit into their teaching futures. Competencies identified through this research project can enhance their perspectives of the potential of microcomputers in vocational education. However, vocational teachers must individually develop personal plans for microcomputer competency that will serve their professional needs as well as the needs of their respective programs.

The decision to develop a plan or not is of utmost importance. Plans can be modified as teachers' computing interests and programmatic needs change with the times. Whatever vocational educators personally decide to do, they should not allow this contemporary technology to pass them by. All vocational teachers must critically examine the role of microcomputers in their professional lives.

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## Unit 1

# Develop a Plan to Implement Competency-Based Instruction in the Vocational Education Learning Environment

### UNIT OBJECTIVE

Upon completion of this unit, the learner will be able to establish microcomputer workstations in the vocational classroom or laboratory. This knowledge will be demonstrated through completion of the achievement indicators at the end of this unit.

### SPECIFIC OBJECTIVES

Upon completion of this unit, the learner will be able to:

1) Describe concerns regarding the establishment of microcomputer workstations.
2) Explain the characteristics of a well planned microcomputer workstation.
3) Discuss the characteristics of an effective microcomputer laboratory.
4) Determine the requirements for networking microcomputers.
5) Plan for the effective scheduling of a microcomputer laboratory.

# Develop a Plan to Implement CBI in the Vocational Education Learning Environment

### BY: DR. ROGER A. RANKIN

### INITIAL PLANNING

When planning for the vocational education microcomputer learning environment, vocational instructors will face a number of concerns. First, and of greatest importance, the individual or team responsible for making decisions about using microcomputers and Computer-Based Instruction (CBI) must determine the needs of the students. Additionally, instructors must ascertain how many students will be working with microcomputers. This information is needed for short- and long-term planning because immediate and future needs will have an effect on the amount of equipment and the physical setting of the microcomputer facility. Instructional objectives are important factors in the initial review of computers and appropriate software to meet instructional needs (Conkling, 1984).

Microcomputers must be compatible with either established vocational curricula or that which is being developed. Vocational teachers must establish curricular needs before any meaningful planning can proceed (Hawkins & Bisbee, 1984). Once these important concerns about vocational curricula have been identified and it has been determined that the need for one or more microcomputers exists, then the selection process for CBI should

start with the identification of the microcomputing features and capabilities needed to match curricular needs (see Appendix A.1). Software that meets these needs must be identified and hardware or microcomputer brands and models that run the required software should be evaluated (see Appendix A.2). Finally, you need to compare various brands being considered on a cost/feature basis, leading to a final purchase decision (Hawkins & Bisbee, 1984). One cannot stress enough the importance of, first, identifying curriculum needs and, second, securing the software to meet those needs. Without the appropriate software, computer users have nothing but an expensive plant stand.

**Individual Setting**

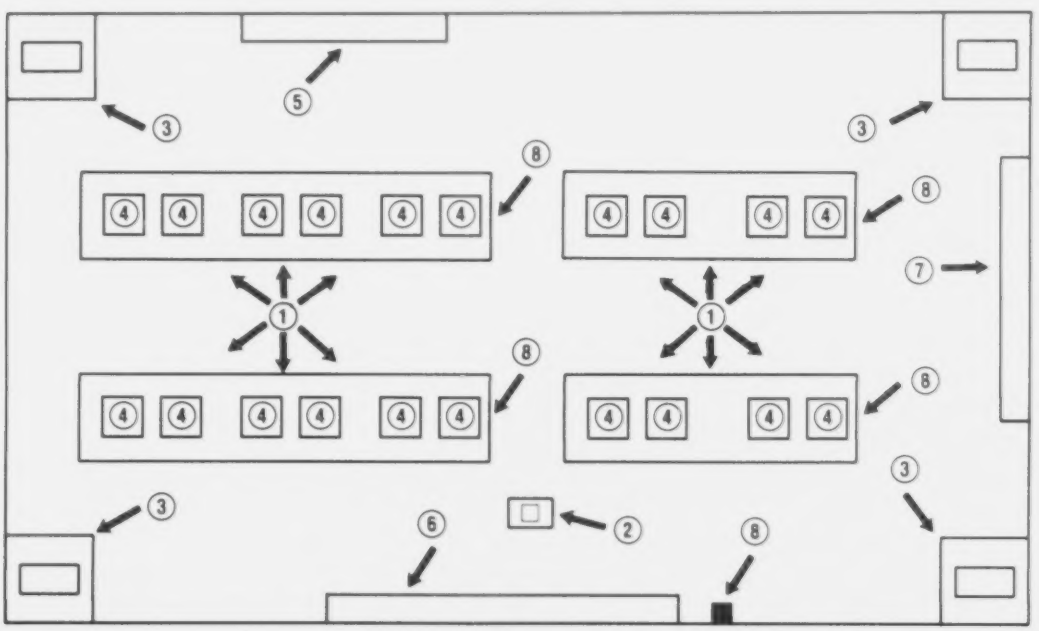
If curricula dictate that a small number of microcomputers shall be used in vocational classrooms, then the designs of those rooms, with regard to microcomputers, should be determined by the respective vocational instructors. An important task is to determine which physical layout of microcomputers best accomplishes instructional objectives. Instructors may determine that objectives are best met by separating computers by placing them in a line along one wall or by building individual learning corrals for student privacy. Consideration of the elements of a good station, coupled with an understanding of how to meet learning objectives will result in a successful environment. When considering the requirements for an entire lab (6 or more computers), instructors must be specific about electrical hookups, tables, etc.; but for the classroom with a small number of computers, a single table, corral, or other type of individual work area, with normal electrical outlets and surge protectors, should be sufficient. The individual microcomputer setting is used when much individual or paired (two students to a machine) activity will occur; therefore, it is not necessary for the instructor to be able to turn on or turn off large banks of microcomputers.

**Lab Setting**

If curricula dictate that a microcomputer laboratory be established (6 or more computers) to meet instructional needs, different concerns will surface regarding the physical setting. Since this type of laboratory is common in educational settings, vocational teachers will have opportunities to use such laboratories.

One assumption regarding a computer laboratory is that the laboratory will be used for the instruction of large groups, using the same computer program in many instances. Another assumption is that the laboratory will be available for various individuals (teacher, student, support personnel, administrator, etc.) to use at various times throughout the day. These assumptions have an effect on the actual physical setting. When large group instruction is taking place (computer literacy, keyboarding, word processing, etc.), the laboratory design must be such that individuals at microcomputers can view the instructor, overhead, chalkboard, and other visuals by simply looking up from the monitor without turning their heads, or turning completely around in their chairs. These two concerns suggest that a very simple design, as shown in Figure D.1.1, should be implemented.

**FIGURE D.1.1**
**MICROCOMPUTER LABORATORY**



KEY: (1) Workstation (30x60x28H)

(2) Overhead projector & stand

(3) Wheeled cart with matrix or letter quality printer

(4) Computer

(5) Bulletin board

(6) Screen and chalkboard

(7) Bookshelves

(8) Electrical switches. (Hawkins & Bisbee, 1984)

Effective instruction requires the laboratory to permit the instructor to walk among small clusters of microcomputers to help individual students. A ratio of 15 students to one instructor is the maximum for effective teaching. The design of the laboratory can aid in the effectiveness of instruction simply by saving the instructor's time expended in moving about the room. Proper lighting, ventilation, and adequate workspace are additional planning considerations.

## A MODEL FOR A COMPUTER LEARNING CENTER

The Houston Independent School District has been at the forefront of integrating computer technology into curricula and instruction for the past several years. Recently this school district began to implement a $140,000.00 U.S. Department of Education grant titled the Computer Learning Center Module Development Project. The Houston project is serving 750 high school sophomores with six teachers implementing the project.

This computer literacy project makes use of seven computer learning centers, each uniquely designed to mesh with the four strands or content areas of the project: Basic skills, computers as tools, computers in society, and future trends.

Figure D.1.2 graphically depicts the features of these learning centers (Sclafani, Smith, & Arch, 1984). Each center has six workstations intended to serve different goals of the project:

1. **The Computer Assisted Instruction Station.**
   This station contains six microcomputers. Students use these machines to run gaming, problem-solving, or simulation software.
2. **The Programming Station.**
   Microcomputers are used at this station to introduce students to programming languages such as BASIC and LOGO.
3. **The Word Processing Station.**
   The project has six microcomputers at this station for the express purpose of introducing students to word processing. The station includes appropriate word processing packages and a printer.
4. **The Hand Held Device Station.**
   This station gives students access to calculators (both programmable and non-programmable), other relevant learning equipment, and at least one portable computer.
5. **The Media Station.**
   This station employs the use of different types of media devices to explore topics relevant to computer literacy. Filmstrip projectors, video cassette recorders, slide projectors, and tape recorders permit learners to benefit from a multimedia approach in examining computer literacy.
6. **The Resource Material Station.**
   This station permits students to try out a number of problem-solving exercises involving research and the analysis of data. Learning exercises at this station require students to formulate future projects based upon current information. (Sclafani, Smith, & Arch, 1984)

The Houston computer learning centers provide vocational teachers with an example of a well planned microcomputer facility. These laboratories are designed to serve a well conceived plan for Computer-Based Instruction within a large urban school district. Objectives were developed for students and staff; specifications were developed for hardware, software, media equipment, resource materials, and other appropriate learning devices for each station. They are good examples of a traditional foundation for architectural design – form follows function.

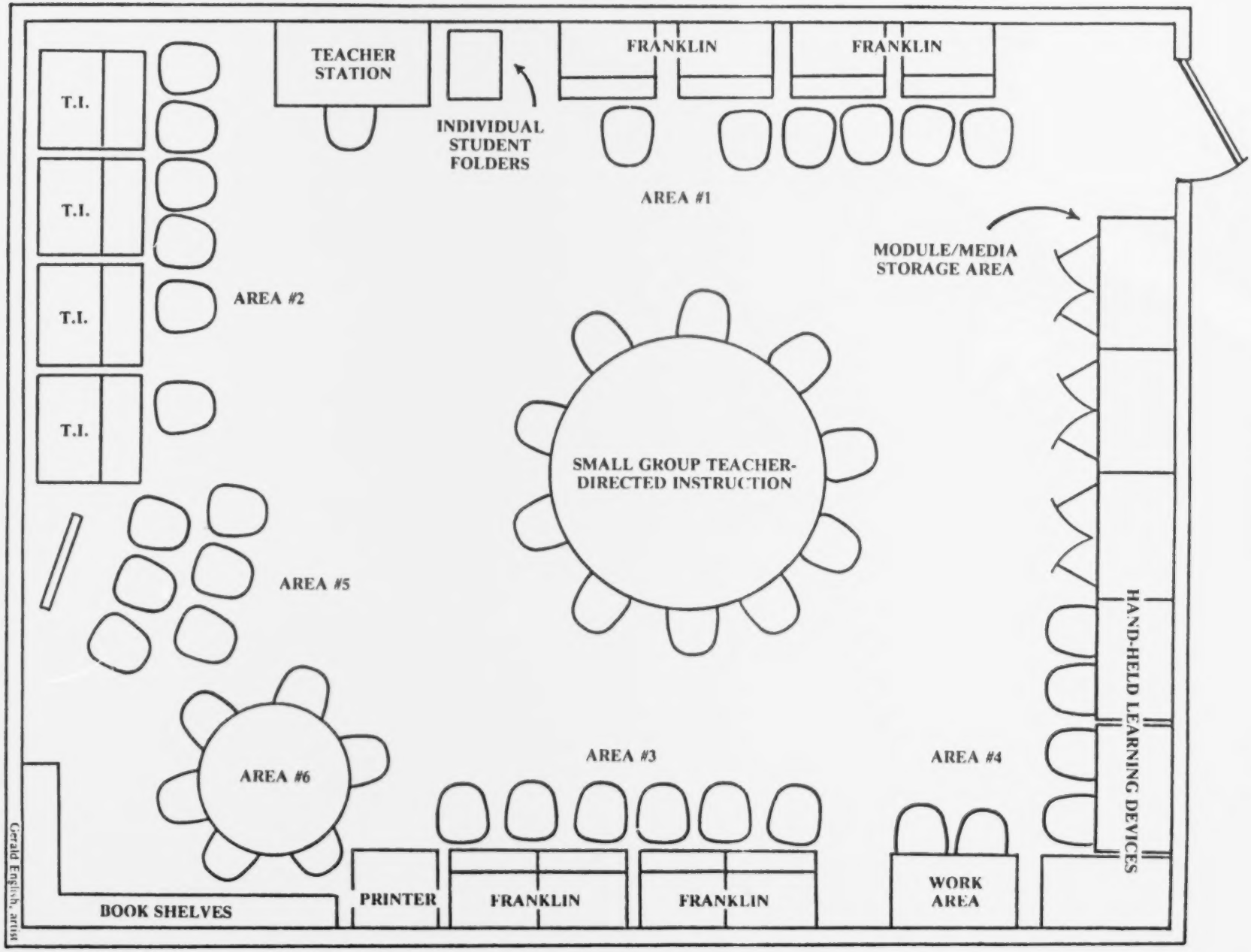
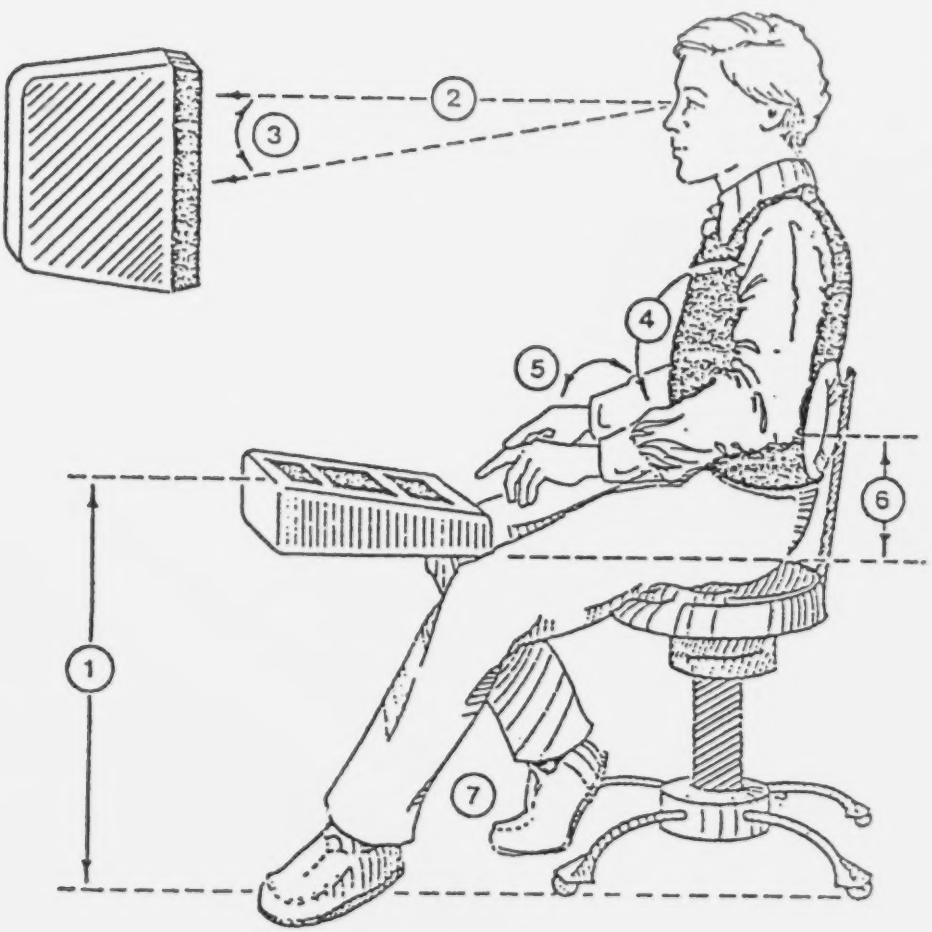

TEACHER STATION
INDIVIDUAL STUDENT FOLDERS
FRANKLIN
FRANKLIN
AREA #1
T.I.
T.I.
T.I.
T.I.
AREA #2
MODULE/MEDIA STORAGE AREA
SMALL GROUP TEACHER-DIRECTED INSTRUCTION
AREA #5
AREA #6
AREA #3
AREA #4
HAND-HELD LEARNING DEVICES
BOOK SHELVES
PRINTER
FRANKLIN
FRANKLIN
WORK AREA
Gerald English, artist

Figure D.1.2

**Workstation Design**

Vocational instructors who integrate microcomputers into vocational curricula must carefully plan the design of individual workstations. An individual workstation may be one computer in a classroom or office, or it may be one of fifteen computers in a laboratory. Typewriting teachers have known for many years that performance is related to the working environment and the same is true with the microcomputer. The individual workstation is made up of a terminal as well as the environment around it. When the National Institute for Occupational Safety and Health surveyed video display terminal (VDT) operators at Blue Shield of California, it tallied the following VDT-related health complaints: eyestrain, 93%; pain or stiffness in the neck or shoulders, 90%; headaches, 89%; burning of eyes, 78%; and blurring of vision, 77%. These statistics point to the fact that, to be most effective, the physical setting of the microcomputer must be given special attention. Figure D.1.1 offers some suggestions to aid in the appropriate setup of the individual workstation.

**Figure D.1.3**




The following workstation specifications (shown in the above drawing) were taken from the NIOSH San Francisco report. The U.S. Military standard for the height of the home-row keys on the keyboard is 29¼ to 31 inches (1). Optimal viewing distance is between 17¼ and 19¾ inches (2). The screen's center should be at a position 10 to 20 degrees below the horizontal plane at the operator's eye height (3). The angle between the upper and lower arms should be 10 degrees or less (5). The keyboard should be at or below elbow height (6), and there should be ample leg room (7).

While recent microcomputer models use monitors designed to reduce eye fatigue, screen glare and characters that are difficult to read are still problems to consider in purchasing a microcomputer. If these types of problems are compounded with inadequate lighting, nonadjustable chairs, and poorly designed work areas in poorly engineered working environments, then serious problems can result.

**Peripherals**

Once each individual station has been appropriately designed and is in place in the proper laboratory setting, then peripherals, as curricula dictate, may be implemented. If printers are necessary, it is possible to have approximately one printer for every five computers throughout the lab. Reasonably inexpensive dot-matrix printers can be used for general use, while a single letter quality printer can be available for more sophisticated hard copy. Curricula dictate the need for and type of printers required in a vocational education microcomputer facility.

Because individuals will use the laboratory for a variety of activities, personal workspace is a critical factor. An individual using a word processing package and printing out hard copy needs ample space for materials and equipment, paper, and other supplies.

**Electrical Considerations**

When designing the laboratory, special concern should be given to electrical setups. All electrical cords should be minimally exposed. Power to computers should come from outlets running along the back of the tables on which the microcomputers are placed. Outlets should be facing inward to allow monitor, computer, and printer plugs to be protected behind the equipment, not exposed to the outside of tables where other students can unplug them or accidentally bump them, turning off the power. As illustrated by figure D.1.1, one main power switch should be available at the front of the room. Each bank of computers should have a power switch and each individual computer should have a power switch that controls all monitor, computer, and printer plugs at the individual station. This electrical configuration allows students to turn off hardware without using the on/off switch, it permits teachers to turn off a bank of computers (this can be useful in some instructional settings), and it ensures that all equipment is off when the lab is closed when the single power switch is turned off.

**Networking and Hard Disks**

Another potential use of the microcomputer laboratory is the networking of computers. Networking means that a "host" computer with at least one disk drive and a network controller can be used to allow the teacher to download or send programs to as many as 16 student workstations (Wallace, 1981). Additionally, networking allows for the sharing of peripherals such as printers, plotters, or disk drives. In the vocational laboratory, for example, there could be 16 computers and one letter quality printer, which would be accessible to any student at any station. Students may send data from their computers to the printer, which produces the information in hard copy form. This is referred to as **resource-sharing networks.**

**Communication networks** let microcomputers communicate with one another, either online (live) or through messages stored on a shared disk. **Interactive networks** allow people to collaborate on multiuser tasks, a capability necessary in large simulations involving a number of students interacting at one time. All of these networks are "local," connecting microcomputers located in the same room or building through a system of wires (Watt, 1984).

In addition to using one microcomputer as the "host" computer, hard disk storage is possible, allowing for software to be stored electronically, freeing the laboratory from needing a large number of duplicate floppy disks. Whether a host computer or hard disk is used, the biggest problem to date is finding software that can be used for networking.

Commercial software is protected against unauthorized copying. Because local networks involve loading software into one computer and transferring it to others (exactly what copy protection is intended to prevent), many educational software packages will not work on network systems (Watt, 1984).

Some firms do make arrangements with software publishers to allow them to adapt software for network systems. Schools will, of course, pay for this service and related programs and materials that may be needed in vocational curricula. Software publishers are also marketing software for networking. Examples of this include various types of software for keyboarding instruction. This type of instruction is perfect for networking, allowing the teacher to access individual stations to observe a student's progress and even allowing the teacher to send messages directly to the student's monitor. When considering networking, instructors should be certain that the curriculum requires this capability, that the use will warrant the arrangement, and that the appropriate software is available. Microcomputer distributors should be contacted for specific information and examples of networking possibilities (NEEUG, 1984; Greitzer, 1984).

The versatility and multiple uses of networking offer tremendous opportunities for vocational instruction compared to the costs involved in establishing a microcomputer laboratory. Networking permits the host computer

to serve as the brain as the additional computers in the laboratory send and receive information from the host. This allows students to use a computer without the added expense of additional disk drives, and it eliminates the need for individual floppy disks for each workstation. Anyone involved with the supervision of a microcomputer laboratory can surely appreciate this process.

## SCHEDULING THE MICROCOMPUTER LABORATORY

Once established, the microcomputer laboratory becomes a popular place and decisions need to be made with regard to the use of the laboratory. Scheduling must include blocks of time for instruction as well as blocks of time for individual use by students, faculty, support staff, and administrators. Since these heavy demands can result in serious conflicts, a well defined set of guidelines must be decided upon and established prior to the opening of the doors (see Appendix B). Once in place, these guidelines can be altered to meet demands, but must be initially in place to avoid problems for the lab supervisor. An advisory committee for the microcomputer laboratory can help prepare laboratory guidelines. A sign-up procedure for the entire laboratory and individual workstations must be in place and a "computer use log" should accompany each individual workstation (see Appendix C). The security of equipment, software, instructional books, etc., is important; the "computer use log" can contribute to the security of the laboratory (see Appendix D).

Too often, microcomputer laboratories become arcades for gaming. While components of gaming can be beneficial to any curriculum, it is suggested that gaming outside of classroom objectives be deterred.

In addition to the lab guidelines and scheduling activities, it is imperative that one individual be responsible for the operation of the laboratory. Since a large financial investment is made in a microcomputer laboratory, a responsible caretaker is a necessity. Student supervisors are useful for checking out software, keeping the lab neat, and helping laboratory users (see Appendix E).

Units D.3 through D.7 provide additional information concerning supplies, equipment, and security of hardware and software.

### User Education

Vocational teachers should assume that the average user of the microcomputer facility is a novice. Therefore, step-by-step instructions should be available for each piece of equipment (see Appendix F). Consultants should be available when the facility is open. For advanced users, manufacturers' manuals for each item should be available.

Workshops may be helpful periodically as user demand dictates. A selection of periodicals related to microcomputers should be available for interested readers. A library of articles pertinent to microcomputer applications in vocational education should be housed in the microcomputer laboratory.

### Implementation

A plan should be prepared which illustrates in detail each step in the development of the vocational education microcomputing environment. The plan should include a timeline for preliminary approval, program objectives review, software review, hardware evaluation, physical site location, site development, and management policy decisions. Potential users should be identified and preliminary training begun, such as exposure to computer magazines and books, software reviews, and workshops.

## SUMMARY

The role of the microcomputer in the vocational classroom must be determined by a fine analysis of vocational curricula. If it is determined that microcomputers can contribute to the curricula and instruction process, then instructors must procure appropriate software. Once this has been accomplished, the purchase of hardware can take place after a cost/feature comparison is completed. Unit B.5 provides additional information regarding the hardware/software procurement process.

Instructors can plan for both individual workstations and microcomputer laboratories. The individual workstation must be planned with regard to the terminals and the work environment. Poor planning at this stage can result in individual workstations that detract from effective learning.

Information provided in this unit regarding individual workstations can be supplemented with additional information in setting up the microcomputer laboratory. Many factors must be considered including lighting, desks, position of microcomputers, electrical hookups, and ventilation.

An additional potential use of the microcomputer laboratory is networking, the electronic connecting of numerous microcomputers with one microcomputer or hard disk acting as a host. While there are many advantages

to networking, one major disadvantage is the utilization of software. Before considering networking, one is encouraged to make certain that it will contribute to the curriculum and that software for networking is available. Networking can considerably reduce the cost of a microcomputer laboratory and ease the management of a software library.

Guidelines for the management and use of the microcomputer laboratory are a must, and can be determined by an advisory committee composed of individuals who will be involved with the laboratory. The laboratory must have an individual responsible for the laboratory who can consider the input of the advisory committee. Effective development and use of the facility can be provided through a detailed plan for implementation and user education.

## ACHIEVEMENT INDICATORS

1) Describe concerns regarding the establishment of microcomputer workstations.

2) Explain the characteristics of a well planned microcomputer workstation.

3) Discuss the characteristics of an effective microcomputer laboratory.

4) Determine the requirements for networking microcomputers.

5) Plan for the effective scheduling of a microcomputer laboratory.

## REFERENCES


Conkling, R. D. (1983, April). The nuts and bolts of selecting a computer assisted instructional program. *Technological Horizons in Education Journal*, pp. 101-104.

Greitzer, J. (1984, October). Local area networks: Choosing one that fits. *PC Week*, pp. 49-61.

Hawkins, H., & Bisbee, K. (1983). Facility planning: Things you should know when planning a computer installation. *Industrial Education, 72* (3), 8-10; 25.

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Sclafani, S., Smith, R. A., & Arch, J. (1984). A model for a computer literacy project. *The Computing Teacher, 12* (3), 39-41.

Wallace, I. (1981). Computers in the typing class? *Business Education Forum, 36* (2), 27-28.

Watt, D. (1983, June). The wired classroom. *Popular Computing*, pp. 70-82.


# Appendix A.1

## MICROCOMPUTER LAB DEVELOPMENT


R. T. Watts
Idaho State University

Date:

Source:

| | |
|---|---|
| Name | Phone No. |
| Address | |
| Hardware | User's Guide |
| Software | Problems |
| Peripherals | Computer Center/Others |
| Network/Databases | Original Proposal/Justification |
| Maintenance | Other Labs |
| Security | |
| Administration | Comments: |
| Hours/Consultants | |
| Who Uses | |

# Appendix A.2

## A COMPARISON GUIDE TO MEDIUM COST PERSONAL COMPUTERS

S = Standard
A = Available
O = Optional
NA = Not Available At This Time

---

**Entry Level With System Features**

Microprocessor (Speed)
RAM Memory
ROM Memory
BASIC

Keyboard

Video display included
Screen Display (lines x char)
Graphics Resolutions and colors

Sound

No. of voices
No. of octaves
Modulator
Audio Cassette I/F
ROM Cartridge Capability

Disk Storage Capability

**Other Features and Options**

Maximum RAM
System RAM Overhead

Maximum ROM
I/O Ports, Other

Disk Storage
Amount of Storage
Maximum No. Drives
Options
Graphics Tablet
Rotary Paddles
Joysticks
Light Pen
Speech Synthesizer
Real Time Clock
Self Contained Unit

**Software/Firmware**

Text Editor
Machine Language Capability
PASCAL
PILOT
Other Languages
Significant digits in BASIC

**Miscellaneous**

Length of Time Product Available

# Appendix B.1

## PLEASE

The purpose of the Microcomputer Learning Facility is to enhance the educational mission of Idaho State University. Use of the facility is limited to members of the ISU community who are utilizing the technology in conjunction with their professional endeavors.

Use Policies:

1. ISU students, faculty, and staff who are engaged in academic endeavors requiring the use of microcomputers have priority over other users.
2. Users are to be responsive to the needs of other microcomputer users and library patrons, i.e., restrict length of use if others are waiting.
3. Maintain a quiet environment.
4. Report problems, need for maintenance, and equipment abuse to Dr. Robert Watts, Director of the Microcomputer Learning Facility, Phone: 2355

Appendix B.2

# IDAHO STATE UNIVERSITY

## Microcomputer Learning Facility

### HOURS*

Monday through Thursday
8:00 a.m. to 11:00 p.m.
Friday and Saturday
8:00 a.m. to 5:00 p.m.
Sunday
2:00 p.m. to 11:00 p.m.

(for group reservations see the Business Office Secretary)

*UNLESS RESERVED FOR A CLASS

# Appendix B.3

## SOFTWARE POLICY

The **current software policy** (not yet implemented because of lack of funds) for the MLF is:

> The operating policy for acquiring software by the MLF is that it shall be limited to items which may be useful by all disciplines or in the general development of computer awareness/literacy. Items which are useful primarily by a specific discipline shall be purchased by that discipline.

**For Consideration by the MLF Advisory Committee**

The following software policies are based upon the notion that software can be provided individually or in combinations of the following:

1. By the individual
2. By faculty
3. By departments
4. By the MLF
5. Other (manufacturers; authors . . .)

One should be concerned with:

a. Acquisition of software
b. Distribution-return of software
c. Use/operation of software
d. Security/safety of software

Implied in this discussion is that the current software policy needs to be changed. Policy examples which might be considered include:

A. **Provide no software**
Software provided only by students, faculty, or departments.

B. **Stay "as is"**
Very limited software available on reserve. Library staff does no checking of software. If software destroyed, not replaced.

C. **Expand software selection**
Implement current policy and operate "as is" (See B.)

D. **Current software with MLF supervision**
Keep current software (if destroyed, not replaced), but make it available only through the MLF supervisors when they are on duty. Supervisors can load and check disks.

E. **Expanded software with MLF supervision**
Implement current software policy (expanded software selection) through supervisors.

F. **Faculty or department responsibility**
Faculty and/or departments take full/partial responsibility for software.

# Appendix C

## GROUP RESERVATIONS

MICROCOMPUTER LEARNING FACILITY

Idaho State University

Month_____ Building_____

Year_____ Computer Type_____

Date:

| | Sun. | Mon. | Tue. | Wed. | Thur. | Fri. | Sat. |
|---|---|---|---|---|---|---|---|
| 8:00a.m. to | | | | | | | |
| 9:00 to | | | | | | | |
| 10:00 to | | | | | | | |
| 11:00 to | | | | | | | |
| 12:00 to | | | | | | | |
| 1:00 to | | | | | | | |
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| 6:00 to | | | | | | | |
| 7:00 to | | | | | | | |
| 8:00 to | | | | | | | |
| 9:00 to | | | | | | | |
| 10:00 to 11:00p.m. | | | | | | | |

# Appendix D

## MLF CHECKOUT SHEET

By signing out the items below you agree not to remove the disks or manuals from the microcomputer center and not to make copies of copyrighted materials.

| DATE | NAME | A or I* | ITEM CHECKED OUT | SUPER'S INITIALS* |
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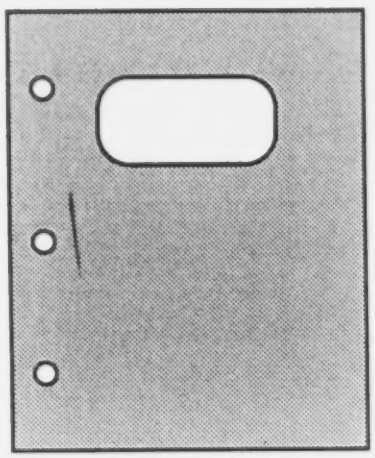
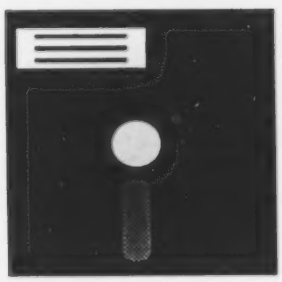
*SUPERVISORS - ENTER AN A OR I FOR APPLE OR IBM SOFTWARE.
ENTER YOUR INITIALS WHEN THE COMPLETE SOFTWARE PACKAGE IS RETURNED.

LOOKING FOR SOFTWARE MANUALS?
PLEASE ASK!





# Appendix E.2

## STUDENT SUPERVISOR'S WORK SCHEDULE

MICROCOMPUTER LEARNING FACILITY

Idaho State University

Month_____ Location_____

Year_____

Date:

| | Sun. | Mon. | Tue. | Wed. | Thur. | Fri. | Sat. |
|---|---|---|---|---|---|---|---|
| 8:00a.m. to 9:00 | | | | | | | |
| 9:00 to 10:00 | | | | | | | |
| 10:00 to 11:00 | | | | | | | |
| 11:00 to 12:00 | | | | | | | |
| 12:00 to 1:00 | | | | | | | |
| 1:00 to 2:00 | | | | | | | |
| 2:00 to 3:00 | | | | | | | |
| 3:00 to 4:00 | | | | | | | |
| 4:00 to 5:00 | | | | | | | |
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| 6:00 to 7:00 | | | | | | | |
| 7:00 to 8:00 | | | | | | | |
| 8:00 to 9:00 | | | | | | | |
| 9:00 to 10:00 | | | | | | | |
| 10:00 to 11:00p.m. | | | | | | | |

# Appendix E.3

## MICROCOMPUTER LEARNING FACILITY

## TIME SHEET

Location _____
Name _____

| WEEK ONE | | | | | | | |
|---|---|---|---|---|---|---|---|
| DATE: | | | | | | | |
| DAY: | SUN | MON | TUE | WED | THUR | FRI | SAT |
| FROM: | | | | | | | |
| TO: | | | | | | | |
| FROM: | | | | | | | |

| WEEK TWO | | | | | | | |
|---|---|---|---|---|---|---|---|
| DATE: | | | | | | | |
| DAY: | SUN | MON | TUE | WED | THUR | FRI | SAT |
| FROM: | | | | | | | |
| TO: | | | | | | | |
| FROM: | | | | | | | |

| WEEK THREE | | | | | | | |
|---|---|---|---|---|---|---|---|
| DATE: | | | | | | | |
| DAY: | SUN | MON | TUE | WED | THUR | FRI | SAT |
| FROM: | | | | | | | |
| TO: | | | | | | | |
| FROM: | | | | | | | |

# Appendix F

AIS 120
Idaho State University

## USING THE CORVUS HARD DISK WITH THE IBM PC'S (BA 404)

### OBJECTIVES

a. You will learn how to sign-on the Corvus hard disk at ISU;
b. You will learn what a UNIT/Drive is and how to change UNIT/Drives;
c. You will learn how to run a TUTORIAL;
d. You will learn how to exit/end a program and end the session with the IBM PC.

Approximate time: 1 hour

### LOADING THE CORVUS BOOT DISK

1. Get the Corvus boot disk from the student supervisor.
2. While the computer is still off, insert the diskette properly (label up; diskette window away from you) in Drive A (left side if there are two drives.)
3. Close the drive door (Press down carefully but firmly).
4. Turn on the monitor using the pull-on knob.
5. Turn on the computer by flipping the switch located at the right side, bottom, rear.

The computer will take about 20 seconds to do a self-test. Then a **red light** on the disk drive will come on while data on the diskette is being read into primary memory. NEVER insert or remove a diskette while the **red light** is ON or you may permanently damage the diskette.

After about 30 more seconds the red light will go off and the screen should display this message:

C O R V U S  S Y S T E M S

CONSTELLATION II
V1.4

PLEASE ENTER YOUR NAME:

If this does not appear on the screen, check:
a. Is the monitor on?
b. Is the monitor "BRIGHT" knob adjusted correctly (light does show)?
c. Do you have the CORVUS BOOT DISKETTE?
d. Reboot diskette (repeat steps 2 - 5).
e. Get help from the student supervisor.

ALWAYS press the return key after you have typed something and want to send it to the computer. The RETURN key on the right looks something like a bent left arrow:

<- - -|

UPPER or lower case letters do not make a difference here. Be careful though, on some software programs it does matter. When error statements occur look for UPPER/lower case problems. The SHIFT key is cleverly disguised as an UP ARROW key.

6. Type USER or user when it asks for your name.

If you entered something other than USER, the computer will respond with a message telling you that what you did was invalid and ask you to press any key to continue. Press any key and the question will be repeated so you may answer it correctly.

If you enter an acceptable NAME the screen will respond with

PLEASE ENTER YOUR PASSWORD: — Note that periods appear on the screen instead of letters
THIS IS NOT AN ERROR!

(If the password security does not come on, do not worry. It just means the computer knows you are a nice person.)

7. The student supervisor will give you the password.
   Enter the password . . . Remember RETURN?

If you have done these steps correctly, you should see the following information on the screen:

Mounted Volume TUTORIALS on UNIT C — These volumes (or
Mounted Volume COMMON on UNIT D — rooms) are avail-
Mounted Volume COURSES on UNIT E — able to you.
Mounted Volume LANGUAGES on UNIT F — Each Volume has files/programs for your use.

The current date is Tue 1-01-1980
Enter new date:

— Unless you just awakened with a long beard or kissed a frog recently this date is probably incorrect; not to worry.

8. a. You can enter the correct date using the exact format, or
   b. Press RETURN and go on.

Current time is 0:11:50:90
Enter new time:

9. Enter correct time using the same format or press RETURN >

***** FINALLY!!! ***** You should see this on the screen:

The IBM Personal Computer DOS — DOS means Disk Operating System.
Version 2.10 © Copyright IBM
Corp. 1981, 1982, 1983

A> — This is the **System Prompt.** The A > means that the computer is looking for the next command in Drive/UNIT A. Drive A is the one you have been using.

**GETTING READY TO RUN A TUTORIAL**

A> — What does this mean?

— Let's practice a TUTORIAL next. The TUTORIALS are on UNIT (or Drive) C. Can you find this information on the monitor screen?

10. — At the A > prompt type C: or c: and press RETURN.

A>C: (RETURN)

C> — Congratulations! You successfully instructed the computer to prepare for commands on UNIT (or Drive) C.
   a. If the monitor doesn't display a C > prompt, then you don't deserve the congratulations.
   b. Did you press RETURN?
   c. If there is an A > showing, retype C: ; it should look like A > C:
   d. Get help from the supervisor.

**USING A TUTORIAL**

11. — To obtain a list of the current tutorials type the following:

C>TYPE MAINMENUE

— You should see a list similar to this:

1. Exploring the IBM PC
2. dBase II
3. IBM DOS
4. IBM CP/M

Type a number from 1 to 4

C>

— If you do not see this message displayed and see the message BAD COMMAND OR FILE NAME, you have probably made a spelling error. Simply repeat the command.

12. C> — At the C> prompt type the number of the tutorial you wish to use. I recommend **1 first and then** 3 from the list above.

C>tutor — To get the LOTUS 1, 2, 3, tutorial.

**TO END A SESSION**

It is good to get into the habit of **completely exiting** or ending a program before you end a session or turn off the computer. Different programs have different ways of ending a program. How did EXPLORING THE PC end . . . ? (Pull out the diskette); how did TUTOR end . . . ? (press ESC).

However the programmer decided the program should end, you will aways end with a System Prompt: C>
A>

13. At this point: be sure the red light on the disk drive is **not ON. Carefully open the disk drive door. Carefully pull the diskette directly out of the drive (if it has not already been removed). You did not** need a diskette in the drive when using the Corvus hard disk.

Carefully place the diskette in its dust jacket.

14. Return the diskette (and manuals, tape recorder, etc.) to the friendly student supervisor.

15. Turn off the monitor and computer.

VOILA!!! You have successfully completed an introduction to using the Corvus hard disk and a tutorial.

Unit 2

# Project Resource Needs for Competency-Based Instruction

## UNIT OBJECTIVE

Upon completion of this unit, the learner will be able to project the static and consumable resources necessary to support Computer-Based Instruction (CBI) in the vocational education classroom. This knowledge will be demonstrated through completion of the achievement indicators at the end of this unit.

## SPECIFIC OBJECTIVES

Upon completion of this unit, the learner will be able to:

1) Describe the functions of four computer workstation components: noise suppressing printer covers, surge suppressors, voltage regulators, and static eliminators.
2) List typical single expense resources for a CBI classroom.
3) List typical consumable resources required in a CBI classroom.
4) Analyze which single expense resources are necessary in specific CBI applications.
5) Project the type and amount of consumable materials necessary to support specific CBI applications.

# Project Resource Needs for CBI

## BY: MICHAEL T. DROTTER

One area of CBI where it is very easy to get into financial trouble quickly is the purchase of supplies to support CBI in the classroom. Purchasing materials to support a CBI program can result in a significant expenditure of operational funds. It is not untypical for computer facilities to spend up to 50% of their total operational funds for consumable supplies. The prudent vocational educator should perform a detailed analysis of support material projections before a fiscal crisis occurs. This unit provides basic information to aid the vocational educator in making computer supply projections. The relative cost figures presented within this unit are average 1984 costs from several large computer supply houses and should be considered to be in the medium to high price range. Substantial savings can be realized over these estimated prices by allowing moderate times for delivery and buying items in larger quantities.

## CLASSIFICATION OF RESOURCES

Resources necessary for computer operation can be grouped into two categories: single expense resources and consumable resources. Single expense resources are those which must be purchased infrequently during the life of the computer system. Consumable resources are purchased frequently to support a CBI program and must be replenished due to deterioration or consumption.

### Single Expense Resources

Single expense resources are those which are purchased only once or very infrequently during the life of a computer system. Unfortunately, many of these expenditures occur at the same time the computer system is purchased. It is also true that many educators either fail to realize the necessity of these items for a successful CBI or they underestimate their cost. Often, these items are either not purchased or are phased in over a long period of time as a result of inadequate resource projections for funding. The quality of the CBI program may suffer because of the lack of these resources.

Single expense resources can be divided into three categories: vital, important, and desirable. For the purpose of this unit, vital resources are defined as resources that must be purchased with the computer system. Failure to purchase a vital resource could lead to costs in excess of the cost of the resource itself. Important resources can be defined as resources that are necessary for efficient CBI implementation, but may be phased in on a short lead time basis. Desirable resources will enhance overall CBI, but can have long term or lower priority phase-in.

## Vital Single Expense Resources

Examples of vital single expense resources are surge suppressors, static elimination systems, dust covers, and hand-held Halon fire extinguishers. Failure to purchase any of these items for budgetary reasons could result in damage to the computer system greatly in excess of the item's cost.

Surge suppressors come in a variety of configurations. Their main function is to filter out damaging voltage spikes in the commercial power supply which could completely ruin the delicate microcircuits within the microcomputer. The simplest and cheapest surge suppressors are called voltage limiting suppressors. Voltage limiting suppressors do not control spikes in the voltage supply until they reach a predetermined severity. The limitation to these devices is that a very severe voltage spike can possibly pass through the device with enough intensity to still damage the microcircuits.

A better type of surge suppressor is the voltage regulating surge suppressor manufactured in two basic types: solid state and magnetic core. Solid state voltage regulators are cheaper than magnetic core regulators, but do not have the voltage regulating capabilities of a magnetic core device. They are much better than a voltage limiting surge suppressor, but can still be over-ranged by the most severe voltage transients. Magnetic core voltage regulators are capable of protecting the microcomputer from almost all conceivable voltage spikes on the commercial power supply. Voltage regulators also protect the computer from most undervoltage conditions which could also cause damage.

The most expensive category of surge suppressors is a voltage regulator with a battery backup power supply. The battery backup power supply provides several minutes of limited power during a power outage to complete a controlled shutdown of the microcomputer to protect data manipulations in progress at the time of the power outage. If the CBI application requires extensive data manipulation that could not be reconstructed in a reasonable amount of time, a backup power supply may be necessary. However, the high cost of these devices (average $400.00 - $600.00 per microcomputer) cannot be justified in most CBI programs.

Voltage limiting surge suppressors cost $40.00 - $100.00 each. Solid state voltage regulators cost $80.00 - $150.00, while magnetic core voltage regulators generally cost between $150.00 and $500.00. Backup power supplies generally add $200.00 to $300.00 to the cost of the voltage regulator with which they are supplied, and therefore could create a total cost between $350.00 to $800.00 each.

Static elimination systems are necessary because static electricity in a person's body could be transmitted directly to vital computer components by touch, resulting in data errors at a minimum and possible damage to microcircuits. It is estimated that a person can have up to 10,000 volts of static charge within the body. When the microcomputer is touched during normal operation, the static charge can be transferred through the electrical circuits of the microcomputer, damaging the microcircuits. Furthermore, this static charge can cause data errors by reversing the polarity of any or all of the memory elements within the microcomputer. Many times, small static charges are the cause of unexplained errors in program output which disappear when the program is re-executed. A static eliminator can solve these problems.

Static eliminators are available in several forms and price ranges, including anti-static sprays, anti-static carpets, and anti-static mats and grounding devices. Anti-static sprays, which are marginally effective for several days after application, cost $8.00 - $10.00 per can. Anti-static rugs or carpets are fairly expensive ($4.00 - $5.00 per square foot) and must be periodically rejuvenated with anti-static spray for optimum performance. Also, anti-static floor mats are totally ineffective if the user wears shoes with high insulation properties such as rubber soles. Probably the best protection for the least price can be offered by anti-static mats that sit under the microcomputer. These mats are touched by the user prior to touching the microcomputer and all static electricity is harmlessly grounded. These mats cost $50.00 - $60.00 each and require no further maintenance because they are electrically connected to the ground on the computer's power supply. Recently, several surge suppressor manufacturers have included a static ground feature with their devices that performs the same function as the static mat at no extra cost. This feature can provide a considerable cost savings to a CBI program with several microcomputers.

Dust covers are relatively inexpensive items that can save much of the repair costs associated with microcomputer systems. The majority of repair costs for microcomputer systems involve mechanical components—specifically, the disk drives and printers. The major cause of malfunctions in these devices is dust and dirt. When properly used, dust covers increase the mean time between equipment breakdowns by protecting components from dust, dirt, and liquids when not in use. Although most microcomputer keyboards are sealed switches to protect them from dirt, liquids can create significant problems. Vinyl dust covers will also protect the keyboard from liquid spills. Dust covers are available for most microcomputer components from $10.00 - $25.00.

The final piece of vital equipment is a Halon fire extinguisher. Although electrical fires in microcomputer systems are infrequent, the possibility still exists. A readily available Halon fire extinguisher can minimize fire

damage. Halon fire suppressant is applied at room temperature and leaves no residue, thus allowing salvage of any components within the microcomputer not damaged by the fire. In contrast, carbon dioxide is very cold when applied and dry chemical fire suppressants leave a heavy residue on all of the computer equipment. Both of these fire agents may create damage in the microcomputer in excess of that caused by the fire itself. Portable Halon fire extinguishers cost between $70.00 and $200.00, depending upon size. One unit in the $100.00 price range should be sufficient for any CBI microcomputer facility.

**Important Single Expense Resources**

Quality microcomputer workstations are as important to the success of CBI as the microcomputer system. Vocational educators often find themselves in a dilemma due to the high cost of furniture for computer workstations. Microcomputer workstations range in price from approximately $450.00 to $1,400.00 for adequate equipment. Some educators faced with this expenditure choose to use standard school furniture. However, standard school furniture causes fatigue for microcomputer users because the most important components (e.g., the CRT and keyboard) are at less than optimum locations for use. User fatigue results in lower CBI efficiency.

Microcomputer workstation configuration is a controversial issue about which many experts have diverse opinions. However, without allowing personal preference to enter the analysis; an assessment of essential workstation components can be made. A flat-table microcomputer workstation to hold the microcomputer and printer, plus an ergonomic chair, costs approximately $600.00. But what are the desirable attributes of a computer workstation? First, the keyboard must be at a handy typing level that cannot be achieved on a standard office or school desk. Next, the CRT must be in a handy viewing position which should be adjustable for each user. Then, an easily adjustable chair (i.e., ergonomic) should be available, not only so that each user can adjust it quickly to a comfortable position, but also so that each user can adjust to several positions during a terminal session to avoid fatigue. Finally, a sturdy printer stand should be available that allows both rear and center-bottom paper feed. Instead of buying the flat-desk type workstation for $600.00, a tilting swivel type CRT stand, a dropleaf keyboard platform, and a sturdy printer stand could be purchased for less than $350.00 to adapt existing classroom furniture to a computer workstation. The pitfall to avoid with this configuration is buying a cheap printer stand. Vocational teachers should spend adequate funds to buy a very sturdy printer stand. These funds or more will be spent eventually when an expensive printer falls from the cheap printer stand due to vibration.

Software support documentation is generally in the form of reference books written to clarify the use of a commercial software packages. These reference books usually provide much more background and detailed explanations than the original software documentation. The use of these references by students can reduce their learning curve for the software and provide a greater portion of student time directed toward CBI applications. These references cost between $15.00 and $30.00 each.

The final area of important single expense resources are program execution aids. Program execution aids are usually in the form of keyboard templates containing the commands and structures of common commercial software packages. These aids provide a ready reference for students during program execution regarding the syntax of commands and other structures which will increase the efficiency of the student at the keyboard. These templates can be purchased for less than $15.00 each.

**Desirable Single Expense Resources**

Although the placement of the previously discussed resources within the vital and important categories may seem arbitrary, the desirable resource category is probably the most open for interpretation. This unit presents some of the more standard items, such as printer sound covers, anti-glare screens, and support accessories. These items are not critical to the operation of a CBI computing area, but will contribute many benefits to a CBI program which are not directly measurable in student performance.

Printer sound covers minimize the background noise of a printer during operation. Most printers emit noise in the 65 decibel range, which is approximately the same as a loud radio. The printer sound cover can significantly reduce this background noise and reduce the resultant student distraction. When purchasing a printer sound cover, teachers should be certain that adequate ventilation is provided to prevent overheating the printer. Convective ventilation can work, but the slots large enough to provide cooling for the printer minimize the sound-dampening effect of the cover. A good quality sound cover with a small cooling fan can be purchased for about $100.00 for a standard microcomputer printer.

Anti-glare screens reduce or eliminate the glare on the CRT screen from lighting in the room. The glare of a CRT screen can cause eyestrain and student fatigue. Glare screens can be purchased from $30.00 to $100.00, with the least expensive generally performing as well as the most expensive. However, instructors should not buy glare screens for CRTs until they are certain that a glare problem exists. These types of glare covers do not enhance CRT optical performance unless there is a glare problem.

Support accessories encompass a wide range of items, many of which are a waste of CBI operating funds. However, many support accessories are useful when efficient computer operations are considered. For example, items such as copy holders are desirable to increase workstation efficiency. However, instructors should purchase as many workstation accessories as possible from standard office supply outlets because the same item in a computer catalog may cost twice as much.

Some examples of desirable support accessories are adjustable copy holders, file cases for floppy diskettes, form bursters, and printout baskets. These items are generally inexpensive, with the exception of the form burster which may cost between $100.00 for a manual burster and $1,500.00 for a top-of-the-line electric multicopy burster.

**Estimate of Costs for Single Expense Resources**

Appendix A provides an example estimate for a CBI program serviced by ten microcomputers. A good standard approach for vocational educators is to evaluate the maximum and minimum cost for all of the single expense resources which an instructor believes are necessary to support the CBI application without regard for available funds. These necessary resources may be a mixture of items from the vital, important, and desirable categories previously discussed. Using this analysis strategy will provide instructors with a matrix of resource options with which to evaluate, rather than an arbitrary list of resource options based upon preconceived notions of what must be purchased to stay within a budget.

Using data provided in Appendix A, Example One, a logical analysis can be performed to optimize resources while remaining within budgetary constraints:

1. Which items must be purchased at the maximum cost?

   Adequate quality can be achieved for all items below the maximum cost.

2. Which items may be purchased at the minimum cost?

   There is no effect on quality if the microcomputer workstation, the anti-static mat, the Halon fire extinguisher, the dust cover, the program execution aids, and the anti-glare screen are purchased at the minimum cost.

For each remaining resource, the analyst must ask: a) why the resource must be purchased above the minimum cost, and b) what is a reasonable cost for the required quality?

3. Voltage surge suppressor

   a. The microcomputer costs too much to repair or replace to trust the protection afforded by the least expensive device.

   b. Since the school is located in a residential area and no large motors are in use at the school that could cause large voltage transients on the electrical power supply, a solid state voltage regulating device can provide adequate protection for approximately $150.00.

4. Printer Sound Cover

   a. The inexpensive printer sound cover does not provide adequate ventilation which may cause damage to the printer over the long term.

   b. A printer with a small ventilation fan can be purchased for $100.00 and will provide adequate ventilation to the printer.

A revised cost estimate is provided in Example Two of Appendix A. This estimate indicates that the cost of the resources as described will be $90.00 over the available funding for each microcomputer, resulting in a $900.00 cost overrun for the ten microcomputers in this CBI classroom.

At this point, the analyst must determine if any other alternatives exist other than reducing the number or quality of the desired resources. Appendix A, Example Three, shows the results of this analysis.

Further research would reveal to the analyst that:

1. A component-type workstation could be purchased for $350.00 (as discussed previously) that utilizes existing classroom furniture.

   This purchase can result in $100.00 savings per microcomputer.

2. A solid state voltage regulating surge suppressor can be purchased that includes a static grounding feature at no extra cost.

   The anti-static mat can be eliminated, resulting in a $50.00 savings per microcomputer.

3. Due to the low probability of a fire in a microcomputer, one small Halon fire extinguisher can be purchased for the entire classroom instead of for each microcomputer.

   This results in a savings of $630.00 in the cost of resources for ten microcomputers.

Example Three indicates that the revised estimate will be $1,200.00 below budgetary limits. The analyst should also realize that the purchase of these resources from a single vendor will result in more savings because ten units will be purchased, and prices from competitive bids will be even lower. These facts will allow the analyst to reinsert the $450.00 workstation into the specifications. The benefit of this strategy is that the CBI program will maintain a very professional appearance in the CBI classroom compared to that possible with the component type workstation and still not exceed budget limitations.

**Consumable Resource Projections**

In the area of consumable resources, there is less need for formal analysis and more demand for realistic use projections. Consumable computer resources are paper, printer ribbons, floppy diskettes, and disk drive head cleaning kits.

**Printer Paper Use Projections**

Many times print paper use is difficult to project because so many variables can affect it. Generally, most CBI classrooms can utilize lower paper grades to save money because most microcomputer printers, both letter quality and dot matrix, are relatively slow. However, with the emergence of the low cost, desk-top size LASER printers in recent years, there is a realization that a LASER printer may be a viable alternative for the CBI classroom (readers are referred to Unit B.5). A high speed printer requires a good quality paper to prevent or minimize paper jams.

Printer paper is most cost efficient when purchased by the box. However, the amount of paper per box can vary from about 1000 sheets to 3500 sheets due to such factors as paper weight and whether the paper is single or multiform. When projecting computer printer paper requirements, use information from other CBI programs to generate the projection. The use factors from the other CBI programs may then be normalized for the number of computer printers and class load in the vocational program.

If no reliable information is available for the CBI area, a reasonable estimate of printer paper use can be made utilizing the following formula:

---

$$\text{Sheets of Paper per Month} = \frac{(\text{Printer Rate in cps})\ (\text{No. of Printer Hours per Day})\ (72{,}000)}{(\text{No. of Characters per Printed Line})\ (\text{No. of Lines per Page})}$$

$$\text{Number of Boxes of Printed Paper Used per Month} = \frac{\text{Number of Sheets of Paper Per Month}}{\text{Number of Sheets of Paper Per Box}}$$

---

An example problem will best demonstrate how these formulas are used. Assume a vocational education classroom has two EPSON FX-100 printers, each used a total of three hours per day. Also assume that the standard output format is 132 character lines with 66 lines per printed page. The EPSON FX-100 printer is rated at a top speed of 160 characters per second (CPS).

Inserting the above information into the first formula yields:

$$\text{Sheets of Paper per Month} = \frac{(160)\,(3)\,(72{,}000)}{(132)\ (66)} = 3967 = 4000$$

Most CBI classrooms can utilize an inexpensive wide computer paper such as 20 pound, 14⅞" X 11" tractor feed paper. This paper is provided with 2700 sheets per box. Use the second equation to calculate the number of boxes of paper that will be required for each printer per month:

$$\text{Number of Boxes of Paper per Month} = \frac{4000 \text{ Sheets Per Month}}{2700 \text{ Sheets Per Box}} = 105 \text{ Boxes}$$

Therefore, two FX-100 printers in this classroom printing 66 line pages with 132 characters per line should use an average of 3 boxes of paper per month. Teachers need to remember that this calculation is only good for the set of stated parameters. Modification of any of these parameters could cause a significant change in printer paper requirements. For example, changing to a 50 line per page, 80 character per line format would more than double the paper requirements. The magnitude of this change is not immediately apparent and could cause severe budget problems considering that the average price for paper is about $40.00 per box. In the case of the example classroom, this small change would cause a $120.00 per month increase in operating costs.

**Other Consumable Resource Projections**

Although printer paper can be an expensive operational cost in the CBI classroom, printer ribbons also provide considerable expense in a computer-based classroom. Many factors affect how long a printer ribbon will last, such as the type of ribbon, the quality of the ribbon, and the type and speed of printer. In fact, the combination of these factors can vary print ribbon life so much that no simple use projection formula can be derived. However, several generalities can be described:

1. Fabric ribbons last much longer than nylon ribbons, but do not produce as high print quality as nylon ribbons.
2. Higher quality ribbons last longer than low quality ribbons of the same type. The problem is that price is not always a good indicator of relative ribbon quality. Trial and error testing in the classroom is the best method of determining ribbon quality; therefore, instructors should not stockpile print ribbons until they have determined which one best serves CBI printing needs.
3. Daisy wheel printers provide longer ribbon life than do dot matrix printers.
4. Print ribbon life is inversely proportional to printer speed.

The best approach to printer ribbon purchases is to determine the type of ribbon that best meets the needs of the CBI classroom prior to making bulk purchases.

**Floppy Diskettes**

Floppy diskettes must be considered consumable resources because, once placed in service, they are either used until worn out or taken by the students as part of the course materials. It is important to provide students with a number of diskettes at no cost because buying them would place a considerable unplanned expense on students who are probably on tight budgets. Providing students with diskettes will also give instructors a certain amount of quality control over the mass storage media used in the microcomputers. Floppy diskettes cost an average of $4.50 each when purchased separately, but a bulk purchase of fifty or more should yield prices on the order of $3.00 to $3.50 each.

**Disk Drive Cleaning Disks**

Disk drive head cleaning kits are abrasive floppy disks with a special cleaner/lubricant for cleaning the read/write heads on a floppy disk drive. One kit will clean a head about thirty times and will cost approximately $10.00. Weekly use of this cleaning disk on each disk drive will prolong the mean time between failures for disk drive head problems.

## SUMMARY

Projecting the resource needs for the CBI classroom is not as easy a task as it first appears. This unit covers only the most universal resource needs of a CBI classroom. Each CBI classroom and subject area instructor must evaluate which resources are required to sustain an active CBI program. Initial single expense resources can easily cost one-third the price of the microcomputer system itself. Proper budgeting for consumable resources is necessary to prevent an expensive state-of-the-art training tool from becoming idle due to a shortage of clerical support supplies.

# Appendix A

## Example One

Example of Single Expense Resource Cost Analysis

| Resource | Minimum Cost | Maximum Cost |
|---|---|---|
| Microcomputer Workstation | $450.00 | $1,400.00 |
| Anti-static Mat | $ 50.00 | $ 60.00 |
| Voltage Surge | $ 40.00 | $ 800.00 |
| Halon Fire Extinguisher | $ 70.00 | $ 200.00 |
| Dust Cover | $ 10.00 | $ 25.00 |
| Program Execution Aids (two per microcomputer) | $ 30.00 | $ 30.00 |
| Printer Sound Cover | $ 70.00 | $ 500.00 |
| Anti-Glare Screen | $ 30.00 | $ 100.00 |
| Total Resource Cost per Microcomputer | $750.00 | $3,115.00 |
| Available Funding per Microcomputer | $800.00 | |

# Appendix A

## Example Two

| Resource | Reasonable Purchase Cost |
|---|---|
| Microcomputer Workstation | $ 450.00 |
| Anti-static Mat | $ 50.00 |
| Voltage Surge Suppressor | $ 150.00 |
| Halon Fire Extinguisher | $ 70.00 |
| Dust Cover | $ 10.00 |
| Program Execution Aids | $ 30.00 |
| Printer Sound Cover | $ 100.00 |
| Anti-Glare Screen | $ 30.00 |
| Total Resource Cost per Microcomputer | $ 890.00 |
| Available Funding per Microcomputer | $ 800.00 |

# Appendix A

## Example Three

| | |
|---|---|
| Total Resource Cost per Microcomputer | $ 890.00 |
| Total Cost Overrun for Ten Microcomputers | $ 900.00 |
| Microcomputer Workstation Cost Saving | $ 100.00 |
| Anti-static Mat Cost Saving | $ 50.00 |
| | $ 150.00 |
| Cost Saving for Ten Microcomputers | $1,500.00 |
| Halon Fire Extinguisher Savings | $ 630.00 |
| Total Cost Savings | $2,130.00 |
| Net Amount Under Budget | $1,230.00 |

## ACHIEVEMENT INDICATORS

1) Using the methods described in this unit and information from local supply houses, configure a microcomputer workstation for under $500.00; $1,000.00.

2) Assume that your classroom has one 200 CPS dot matrix printer to support five microcomputers. As a result, that printer is operating six hours per class day. Using standard printed output parameters for your classroom (assume 132 character lines and 66 line pages if no standard exists), project how much paper will be used in your classroom in one year.

3) Using the quantity derived in question No. 2, estimate the cost of printer paper for your classroom.

4) Make a list of all consumable supplies required to operate your CBI classroom and project annual resource quantities.

5) Using the data from question No. 4, estimate the cost of consumable supplies for your classroom for one year (hint: the experienced requisitioner usually applies a 10% minimum contingency factor).

6) Describe the function of these microcomputer workstation components and list any special considerations when purchasing:

   a. **Noise Suppressing Printer Covers**

   b. **Surge Suppressors**

   c. **Voltage Regulators**

   d. **Static Eliminators**

Unit 3

# Provide Microcomputer Maintenance

## UNIT OBJECTIVE

Upon completion of this unit, the learner will be able to perform simple microcomputer maintenance. This knowledge will be demonstrated through completion of the achievement indicators at the end of this unit.

## SPECIFIC OBJECTIVES

Upon completion of this unit, the learner will be able to:

1) Compare the cost of a maintenance contract with the estimated cost of self-performed maintenance for microcomputers.
2) List items that should be kept for a microcomputer laboratory parts inventory.
3) Discuss power line protection.
4) Explain the importance of involving users in microcomputer maintenance.
5) Provide a brief description of preventive maintenance for the following components:
   A) software
   B) boards/cards, plugs, cables, and connections
   C) disk drives
   D) printers
   E) monitors
   F) microcomputers
6) Discuss tasks and responsibilities of a microcomputer maintenance schedule.
7) Discuss common symptoms of microcomputer malfunctions and provide possible solutions.
8) Explain steps for getting help to solve microcomputer malfunctions.

# Provide Microcomputer Maintenance

BY: DR. ROBERT WATTS

### Maintenance Warranty

When microcomputers are purchased, they come with a 30 to 90 day warranty on hardware. This warranty may not cover labor, transportation, or handling charges. Instructors who bid for microcomputer purchases should be sure to include a section in the bid specifications for maintenance warranty. Often such a warranty can be included at no extra cost.

### Maintenance Contract

The manufacturer or dealer may offer an extended maintenance warranty which may be either a standard contract available to all purchasers or a special contract designed for a specific organization. Instructors should compare the cost of a maintenance contract for one year with the estimated cost of inhouse maintenance of the microcomputers. These estimated costs will vary quite a bit depending on the amount of maintenance instructors are willing and able to perform, the number of microcomputers involved, and their amount and types of use. For instance, if instructors allow games to be played on microcomputers or if microcomputers are frequently transported to different locations, then maintenance costs can escalate.

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The writer of this unit coordinates a microcomputer facility. Because the maintenance contract for this facility would almost equal the cost of one complete microcomputer system, it was decided that the cost was prohibitive for the service. As a result, in a little over one year, less than $500 has been spent for service and materials on 16 Apple II + s which receive heavy use in a public location. However, this amount does not include time spent by staff performing regularly scheduled preventive maintenance, trouble shooting, repairing, pick-up, and delivery. A maintenance contract may be a more appropriate strategy if staff members prefer to spend their valuable time doing things other than providing microcomputer maintenance.

**Do It Yourself**

There is a good chance that a committee will decide to save some money up front and not purchase a maintenance contract . . . and then leave the job of keeping the microcomputers in working condition up to the instructor. With this in mind, vocational teachers should remember an important point: 80% of all microcomputer problems are caused by humans. Be careful; don't be one of the problems.

The ideal situation is to have one or more trained, full-time service persons take care of all microcomputer maintenance in the organization. Martin Marietta Data Systems estimates that you need one maintenance specialist for every 125 microcomputers. Look for an individual with some electronics background and an interest in microcomputing. Training is often available from the microcomputer manufacturer, from a local dealer, or from computer maintenance schools.

Because of the large number of microcomputers and other electronic equipment on this writer's campus, there has been a need for a full-time maintenance person. A considerable amount of time is wasted by faculty, staff, and students trying to overcome simple problems, many of their own making, that a trained person could easily solve. The cost effectiveness of this particular situation has not been established at this campus, but it is an arrangement that each organization should carefully consider.

Another alternative for maintaining microcomputers is to have a part-time staff person responsible. This person should have some training on the institution's equipment, preferably from the manufacturer or dealer. When large group purchases of microcomputers are made, instructors should include maintenance training as part of the purchase. This can be negotiated as part of the regular training program or specified as part of the bid/purchase.

**Budget and Inventory**

If instructors do not have a maintenance contract, they should set aside budget money for general parts and labor. This writer monitors 15-20 microcomputers in each location and budgets $1,000 per location per year for general maintenance. This amount has not been spent on maintaining the microcomputers as yet, but, as they get older their maintenance costs increase. This policy provides money for unexpected major expenses.

An inventory of spare parts will cost under $500 and help save time, frustration, and perhaps money during the year. Instructors should consider keeping an inventory of spare parts only after they have had training. With help from local dealers, teachers can keep equipment in good working order with very little down-time. Items which might be included in a small parts inventory can vary considerably, depending upon the type(s) of microcomputer(s) within the facility. Items which the writer keeps for the Apple II + include:

| | | |
|---|---|---|
| 1-2 Power Supplies | $100/retail | $48/exchange |
| 1 Keyboard Encoder Assemble | $56.00 | |
| 2 Keyboard Encoder Chips | $16.00 | |
| 1 Disk Interface Card | $80.00 | |
| 1 Disk Analog Card | $68.00 | |
| 8 4116 II + RAM Chips | $68.00 | |
| 6 Disk Read/Write Tabs | $ 5.95 | |

Other items which instructors will need include:

Disk head cleaner
Small vacuum cleaner
Set of small tools
Trash containers

**Setting Up The Physical Location**

Vocational teachers may have little choice on where microcomputers will be located. For ease of supervision and security, instructors should seek a central location with air conditioning (for humans, not microcomputers). For maintenance purposes, a room in the interior of a building will allow less dirt to be tracked in. Teachers should also

be aware of problems that might be caused by static electricity. If static electricity is a problem, instructors may need to purchase static electricity suppressing mats or spray. Teachers should determine where microcomputers should be placed for teaching purposes, coordinating their placement with the location of tables and chairs. Instructors must locate outlets so that tripping over and vacuuming around loose electrical cords can be avoided.

### Power Line Protection

Power spikes, surges, noise, and glitches: unsuspected changes in the flow of electrical power to microcomputers may cause problems which are incorrectly blamed on hardware or software. One sees examples of these problems when the lights dim momentarily or when the TV picture flutters. When choosing a microcomputer location, instructors should watch out for nearby large generators, compressors, and elevators. Lightning can melt the insides of microcomputers.

Teachers should not take chances. They should protect their investments. Instructors may wish to investigate this topic further by reading magazine articles and studying manufacturer's literature. By way of comparison, this writer invests about $75 for each protection device, including a power strip with six outlets.

## GETTING STARTED

#### User Helpers

The facility is set up; the micros are plugged in; everyone is eager to get started . . . it is time to train users, especially the regular ones, to help with maintenance. Instructors should begin by developing common sense rules and posting them in the facility. Dirt, dust, food, drinks, smoking, and snacks are very harmful to microcomputers. Sooner or later, crumbs, pencil lead, paper clips, lint, and pieces of paper will be found inside the microcomputers. Careful operation by users can minimize many of these problems which will make the instructor's life as a maintenance person easier and lengthen the useful life of the microcomputers.

Users must develop the attitude that if something goes wrong, they should report it immediately. Users should perceive reporting problems as a positive gesture rather than a negative task. They should not feel that they "broke the equipment" and may be punished for it. This is true of software use as well as hardware use. The sooner instructors encounter problems and the more complete and correct a description they receive regarding the problem, the easier it will be for correct maintenance to occur, whether that maintenance is done by the instructor or by a service person.

Remember, most problems are caused by humans. Teachers should help users learn about what they are doing and why, and how problems occur and are solved. As users develop these attitudes and skills, the number of strange maintenance problems will diminish.

#### Internal Architecture

Instructors should learn about the fundamental components or modules that make up their computer systems prior to attempting maintenance work. They should begin by reviewing the manuals that come with each piece of hardware. Instructors should watch the vendor install the systems in each location; they should help out and ask questions at this time. During training sessions, teachers should learn as must as possible about the microcomputer and peripherals. Vocational teachers should talk with service personnel about common problems that they see, and about what can be done to prevent and correct such problems.

## PREVENTIVE MAINTENANCE

#### Software Do's and Don'ts

Users must be warned to refrain from writing on floppy diskettes with a pen, placing diskettes on top of disk drives, placing heavy items on top of diskettes, and putting fingers directly on the magnetic metallic oxide surface at the read/write opening. One of the most important maintenance tasks that must be done is to **obtain or make backup copies** for all software that is valuable to the vocational instructor. Instructors should place original software in a safe place and use backup copies. If a diskette is slightly damaged or data are lost, it is sometimes possible to save the data. Data recovery software is available commercially and instructors may wish to obtain one of these and practice using it for the eventual day that hopefully will never come.

#### Boards/Cards, Plugs, Cables, and Connections

It is wise practice for instructors to always read the manufacturers' instructions carefully before installing equipment. Teachers should also reread this material occasionally as they become more familiar with equipment.

Instructors should check that all boards and plugs are inserted in **correct locations** and that they are **pushed in** all the way. If plugs include small screws as part of their installation, they should be used to avoid problems later.

There are boards/cards available with extra memory for the disk drives, printer, and other peripherals. These boards should be checked periodically. The following procedures should be observed:

a. Do not touch the gold "fingers" on the boards. Even clean hands can cause a bad connection.

b. Clean the gold connections carefully by using commercial solutions or by using a clean eraser on the end of a pencil. **Do Not** do this over the open microcomputer and **be sure** all eraser material is wiped from the board using a clean, lint-free cloth.

c. Insert the boards properly and press them down securely. Follow the manufacturers' directions carefully and be sure the boards are seated or pressed down all the way.

d. Boards and other connections can be seated very securely and still not make proper connection. Over a period of time corrosion can form in the slots in which boards reside. Periodically, take out all the boards in each system and clean them.

**Disk Drives**

The disk drive is usually used more often than any other device. With mechanical as well as electrical parts, it is subject to wear and potential breakdown. A regular schedule of preventive maintenance on disk drives will be helpful in preventing unexplained read/write errors, lost data, and software that will not load. Instructors should purchase a good disk drive diagnostic program/kit or a general diagnostic package for their systems which includes a diagnostic program for the drives.

Dirt and metallic oxide from the floppy diskettes can build up on the read/write head in the disk drive. A quality disk drive cleaning kit can be used to solve this problem. Cleaning diskettes which come in wet or dry form, should be used on a regularly scheduled basis—but not so often as to wear down the head.

After cleaning the disk drive head, instructors should follow the directions for using a disk drive diagnostic program. The programs generally allow users to check and adjust the speed of the drive. Instructors should also check the actuator arm that searches for each track and check the amplitude. A noisy disk drive may need a small amount of lubricant. Instructors should refer to the user manual for the recommended type and amount of lubricant.

**Printers**

Printers also have many mechanical as well as electrical parts that may cause problems. The reliability of printers is generally good, but there are concerns for instructors to keep in mind:

a. The very worst problem this writer encountered was caused by human misjudgment. A person tried to run mailing labels through the dot matrix printer without making the proper adjustment for thicker paper. The gummed labels jammed behind the roller and it took an hour to take the label gum off all the parts.

b. Instructors can maintain the clarity of the print by cleaning the printer "type" regularly. The letter quality daisy impact daisy wheel can be cleaned the same way one cleans a typewriter. The wires in the dot matrix print heads are easily cleaned. Instructors should read the printer manual and learn how to remove the print head. Cotton swabs can be used to dab alcohol on the pins of the print head. One should try to get the alcohol to penetrate from the back of the print head as well as the front.

c. Pins on the dot matrix print head may wear down and instructors will find the print is not as dark as it once was. This wear is especially prevalent if the printer has a metal backing bar instead of a rubber one on which the pins strike.

d. Printer ribbons may dry out before they wear out. If the ribbon is not worn or frayed, it may be reusable. Re-inking devices, both hand operated and motor driven, are available commercially. They get mixed reviews in magazines, but instructors may wish to try using such devices.

Typewriter/printer ink is different from other types of ink. The ink used on dot matrix printers includes a lubricant that helps keep the pins free. Instructors must be sure to use the proper kind of ink or they may have to replace an $80 print head.

**Monitors**

The monitor is a reliable device that needs little care. When things go wrong, it is usually with the monitor board or cable. Overheating in the microcomputer can cause a broken pattern on the screen. A small fan (available

commercially) can be installed on the inside or the outside of the microcomputer to take care of heating problems. Instructors should clean monitor screens regularly with glass cleaner and check color and contrast with the diagnostic disk or color demonstrator program on the master disk.

**Microcomputers**

If instructors keep microcomputers clean, inside and out, keep filtered power coming into the systems, and keep users out of the microcomputer, they are well on the way to a relatively problem-free, reliable system. Dust, dirt, poor electricity, and humans are the cause of most maintenance problems.

On a regularly scheduled basis, instructors should use diagnostic diskettes to check microcomputers. Tests may include a check of ROM (read only memory), RAM (read from and write to memory), the language card with extra memory, peripheral cards such as printer and disk drives, and the keyboard. Instructors should read the directions for the diagnostic diskette carefully. As part of a preventive maintenance program, it is doubtful that anything will be found wrong with the diagnostic disk. Problems should have been fixed when they were first identified, but it does bring peace of mind to know that everything is all right.

Instructors must be certain that the microcomputer is turned off before working inside it. A small vacuum cleaner can be used to clean dust and bits of paper from the inside of the microcomputer. Instructors can take the cover off, turn the microcomputer over, and turn it back and forth gently to listen for rattles. Unwanted things such as paper clips should fall out.

All connections should be checked for a firm fit. A common problem with the RAM, ROM, and other chips is that they work loose due to the slight expansion and contraction that occurs from heating and cooling as the system is turned on and off. Once instructors are sure the microcomputer is turned off, they can carefully press down on each chip, on the motherboard and the other boards, to reseat the chips. Doing this on a regular basis can eliminate many problems before they arise.

At the conclusion of these maintenance tasks, instructors should recheck all outside connections and then load and run a sample program. The system should continue to work properly until the next regularly scheduled maintenance.

**Scheduling**

The following is a sample microcomputer maintenance schedule for a facility that might be used fairly heavily. Instructors should modify the schedule to fit their needs, and decide **who is responsible for doing tasks** and **who is responsible for seeing that they get done.**

**Microcomputer Maintenance Schedule**
(heavy use)

**Daily**

Vacuum/sweep floors
Empty trash cans
Pick up and straighten room
Check light bulbs/lighting
Keep bulletin boards current
Respond to problems reported

**Weekly**

Vacuum inside microcomputers
Press down all chips
Check all outside connections
Vacuum inside printers

**Monthly**

Thoroughly clean and vacuum inside printers
Diagnostic check of microcomputers
Diagnostic check and realignment of disk drives
Check monitor settings
Clean cooling fans
Clean printer type heads

**Quarterly**

Clean disk drive heads (do not overdo head cleaning: it is abrasive).
If possible, rotate disk drive A(1) and B(2) to maintain even use and wear.

**Yearly**

If possible, have all systems checked properly by a local dealer.
Clean all boards, slots, and connections.
Review manufacturers' manuals.

## COMMON PROBLEMS AND WHAT TO DO

A. **Power light does not come on**

1. Is the microcomputer plugged in?
2. Check the switches at the outlet or power line conditioner. Are they on?
3. Is the fuse blown or circuit breaker off? This seldom happens, but if the power light does not come on and everything else has been checked, this might be the problem. Check your user manual for information and specifications. If the fuse blows after being replaced, check with your local dealer.
4. The switch on the power supply may be bad. Does it feel "soft?" Is there any unusual noise at the switch?
5. The power supply may be bad. Switch with a spare power supply and see if that solves the problem.

B. **Power is on, but the disk drive just sits there when it should be loading.**

1. Turn the power off. Press the chips down on the disk drive board.
2. Check the gold "fingers" to see that they are clean and insert the board properly.
3. The power supply may be defective and not supplying enough power to start the disk drive. Check with a spare power supply.
4. The analog card in the disk drive may be defective. Replace.

C. **Disk drive is working, but the diskette is not loading, I/O errors or intermittent load.**

1. Is the disk drive door closed?
2. Stop the disk drive. Wiggle the diskette slightly to reseat it and try to load again. When a diskette does not load, this is a common error.
3. Is the diskette formatted correctly for the microcomputer being used? Insert another floppy diskette that is known to be good and see if it loads properly.
4. If possible, do a diagnostic check on the disk drive and on the RAM card. Replace RAM if needed.
5. Do a ROM test. Replace ROM if needed.
6. Check disk drive analog card. Replace if needed.
7. Check disk drive interface card. Replace if needed.
8. Have dealer check disk drive mechanical assembly.
9. Have dealer check motherboard. Replace if needed.

D. **Disk drive seems to be working, but there is nothing on the monitor screen.**

1. Is the monitor turned on?
2. Are the monitor screen controls adjusted properly?
3. If there is a 40/80 column switch, probably on the back of the microcomputer, check the position of the switch.

E. **Disk drive loads program, but there are strange patterns on the monitor screen.**

1. Adjust monitor controls.
2. Turn power off for 15 seconds; reboot the same diskette.
3. Try loading a diskette that is known to be good. The first disk may be bad.
4. The microcomputer may be getting overheated. A cooling fan may need to be added.
5. Check the power supply to see if it is too weak to load a disk.
6. If possible, check the RAM and ROM chips.
7. Have a local dealer check the motherboard.

F. **I/O Errors**

See section C. above.

G. **Keyboard "bounce"—This happens when a key is pressed once and the character repeats several times on the screen.**

1. Run the keyboard test on the diagnostic diskette. Clean board contacts as needed. Replace individual key or whole keyboard as needed.
2. Check keyboard encoder chip. Replace as needed.
3. Check the keyboard ribbon cable at the motherboard. Reseat it.

H. **Microcomputer seems to go "dead," but the power is on and the program is still on the screen.**

1. If data were sent to the printer or other peripheral, is the peripheral turned on?
2. Was power sent to an empty slot in the computer, either by the program or by the user? Reboot if necessary.

I. **Printer (or other peripherals) will not work.**

1. Is the printer plugged in and turned on?
2. Is a cover open? Peripherals often have an interlock switch that will prevent them from working when a cover is open.
3. Are all interface connections secure? Plugs sometimes work loose, especially when equipment is moved occasionally.
4. If it has a "paper out" switch, is the paper inserted correctly?
5. Is the program operating correctly? If possible, try the program/disk on another microcomputer and printer.
6. Is the printer interface card clean and plugged in properly?
7. Is the printer cable and connections correct for your system?

## THE NEXT STEP . . . OR, HELP!

### Getting Help

If instructors encounter a problem which is new to them and not easily solvable, they should look for help. However, they need to remember that more problems are caused by people than by any other single reason. Before getting help, instructors should secure some important information:

1. **Write down** all symptoms of the problem: a light does not go on; a disk does not load; there is a noise; etc.
2. **Get samples** of the problem: several printouts showing poor results; a diskette that has been eaten by the drive; a strange looking piece of plastic.
3. **Write down the order** in which things happen as the user can best remember them. The order may be very important in helping to determine more easily and quickly what is wrong.

If the instructor has a good relationship with the local microcomputer dealer, a telephone call may quickly establish the problem and determine the solution. It may also be determined that the best thing to do is to take the microcomputer, peripheral, or system into the dealer for testing by more highly trained technicians on sophisticated, expensive test equipment. Instructors shouldn't expect miracles from a phone call!

If there is a microcomputer user group in the community, either one of a general nature or one that specializes in a particular manufacturer's equipment, it could be very useful for the instructor to become actively involved with the group. If there is not a user group in the community, it might pay off for the instructor to get one started.

Drastic maintenance problems may require a telephone call to the manufacturer. It will be a rare occasion when the local dealer cannot help the instructor, but it can happen. Instructors should find out if there is a manufacturer's regional or national maintenance center, what kind of support they are prepared to give, and, if possible, a specific telephone number and name to contact for help in an emergency.

### Microcomputer Maintenance Training

To improve microcomputer maintenance skills and knowledge, maintenance workshops and courses are offered by local dealers, colleges and universities, manufacturers, and commercial schools. Books, magazine

articles, and several correspondence courses about microcomputer maintenance are available. Instructors should start with the list of selected references for this unit. They should develop their own maintenance resource areas by organizing articles, manufacturers' literature and specifications, parts catalogs, and other useful material.

## ACHIEVEMENT INDICATORS

1) Compare the cost of a maintenance contract with the estimated cost of self-performed maintenance for microcomputers.
2) List items that should be kept for a microcomputer laboratory parts inventory.
3) Discuss power line protection.
4) Explain the importance of involving users in microcomputer maintenance.
5) Provide a brief description of preventive maintenance for the following components:
   A) software
   B) boards/cards, plugs, cables, and connections
   C) disk drives
   D) printers
   E) monitors
   F) microcomputers
6) Discuss tasks and responsibilities of a microcomputer maintenance schedule.
7) Discuss common symptoms of microcomputer malfunctions and provide possible solutions.
8) Explain steps for getting help to solve microcomputer malfunctions.

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Unit 4

# Establish Microcomputer User Data Security

## UNIT OBJECTIVE

Upon completion of this unit, the learner will be able to implement security strategies to protect microcomputer users from the accidental loss of data. This knowledge will be demonstrated through completion of the unit achievement indicators.

## SPECIFIC OBJECTIVES

Upon completion of this unit, the learner will be able to:

1) Name six storage media for computer data.
2) List three possible threats to the security of data associated with the two most often used categories of storage media.
3) Discuss a management scheme that will offer users a reasonable degree of security given a particular situation.
4) Discuss the impact on system and facility costs of several alternative methods of implementing user data security.
5) Compare the classroom management of alternative methods of implementing user data security.
6) Describe the impact on the user of several security schemes from three perspectives: ease of use, degree of security, and transmission of skills into the real-world work environment.
7) Develop a curriculum unit for teaching users how to protect data from accidental loss in the classroom.

# Establish Microcomputer User Data Security

BY: DR. ROBERT WATTS
DR. WAYNE DAW

The old maxim "easy come, easy go" has a significant meaning relative to the use of computers. In fact, its significance has undoubtedly brought even the most ardent lover of technology a few hours of genuine depression. Computer novices soon discover the importance of learning the how, when, and where of data storage. The accessibility of particular storage media on computers is inversely proportionate to reliability. Reliability, in turn, affects cost.

### Random Access Memory

Random Access Memory (RAM) is the storage medium used by computers to store information on a temporary basis where it is readily accessible to the Central Processing Unit (CPU) or microprocessor. RAM is usually very reliable as a means to accurately store information. If information is lost, it is usually a result of a loss of power to the computer or some other irregularity in the power supply. Other causes of data loss in RAM are operator errors or the discharge of static electricity.

Steps needed to protect equipment against data loss due to irregularities in the supply of power could be as simple as doing nothing or as troublesome as hiring a consultant. However, simple observations about the electrical system will help instructors with these situations. If there are electrical grinders, lathes, or other high demand power equipment in the same facility as the microcomputers, then instructors will probably need to install protective devices between the computers and the main power supply. Vocational instructors may need to seek advice from technicians regarding the type of device to install. A simple surge protection and noise filter device may be purchased at computer stores for under $100.00.

Computers lose power in three locations: a) the cord from the computer to the wall socket, b) the circuit breaker panel, and c) the power company. Cords should be placed where they have minimum exposure. A good approach is to fasten them under tables or put them in rubber or metal channels. In certain circumstances it may be possible to use undercarpet wiring (Thomas & Betts Corp., Raritan, New Jersey, manufactures undercarpet wiring). Instructors should lock the door to the circuit breaker panel and label circuit breakers that serve specific circuits.

Static electricity can destroy data stored in RAM. However, modern microcomputers are designed to prevent static electricity from interfering with the operation of the computer. The source of static electricity is usually carpet, which should be periodically sprayed with an anti-static solution and should solve static electricity problems. Static electricity may also create problems such as voltage spikes on the power circuit. Instructors should install a noise filter/surge supressor between the computer and wall socket to alleviate such problems. Instructors will be wise to follow three pieces of advice regarding microcomputer laboratories: a) neatly hidden cords and cables are better than a mass of trip wires, b) tile floor covering is better than carpet, and c) power supply protection is better than being struck by lightning.

**Data Security on Removable Disk Media**

Manuals provided by computer manufacturers are the best guide on how to backup and safeguard data stored on removable disk media; teachers should read the instructions carefully. During the process of storing data on removable disk media, it is possible to lose data if there is a problem with the power supply. Advice that applies to protecting RAM applies to this situation. Information on disk media can be destroyed when it is not in the disk drive if it is exposed to a strong magnetic field or if the surface becomes dirty or worn. Instructors should check new disk drives to ensure that the recording head is not plowing little grooves into the media. The best protection against losing data stored on disks is to make a backup copy of the disk and store it in a safe place.

**Data Security on a Hard Disk Drive and Network**

A hard disk drive can provide years of trouble free service if treated properly. However, a hard disk drive cannot withstand physical abuse. Most hard disks are in sealed units to protect them from dust. This protection is necessary because the read-write head floats within a thousandth of an inch of the recording surface. A small amount of contamination can damage the disk surface. The surface of the disk can also be damaged if the disk drive is subjected to physical shock or excessive vibration during its operation. To protect a hard disk system from loss of data due to irregularities in the power supply or loss of power, it is advisable that the unit have an AC POWER BACKUP UNIT designed for computer systems. A typical unit, which costs between $300 and $600, is provided for the GUARDIAN ANGEL (reference manual, 82):

> The GUARDIAN ANGEL is a battery-powered, AC power backup unit which keeps any of the popular microcomputer systems and instruments operating during AC power interruptions or transients. The 150 Watt unit is capable of powering such systems as the Apple II with monitor, or Apple III computer with monitor and Profile fixed disk.
>
> In addition to conditioning the input AC line voltage, the GUARDIAN ANGEL will provide emergency backup power from the
>
> Internal Battery . . .
> Output Power (Watts, Full Rated Load) 150 . . . . . .
> Holdup Time on Internal Battery (Minutes)
> At Full Rated Output Load 2-6 . . . . . .
> At Half Rated Output Load 15 Typ . . . . . .

Software that comes with a hard disk drive should allow password protection for users. If such protection is not available, the next best alternative to insure that users do not inadvertently destroy each other's data is a tree structured directory system. A password protection scheme with facilities for a tree structured directory offers an excellent combination. Another very useful software device that may be included in the operating system for a hard disk is the ability to select whether or not the user has READ ONLY ACCESS to a volume on the hard disk or READ WRITE ACCESS. A network system with all of these management facilities and hardware will provide excellent protection for the user's data.

## ACHIEVEMENT INDICATORS

1) Name six storage media for computer data.
2) List three possible threats to security.
3) Discuss a management scheme that will offer users a reasonable degree of security given a particular situation.
4) Discuss the impact on system and facility costs of several alternative methods of implementing user data security.
5) Compare the classroom management of alternative methods of implementing user data security.
6) Describe the impact on the user of several security schemes from three perspectives: ease of use, degree of security, and transmission of skills into the real-world work environment.
7) Develop a curriculum unit for teaching users how to protect data from accidental loss in the classroom.

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### Unit 5

# Establish Microcomputer Hardware/Software Security

## UNIT OBJECTIVE

Upon completion of this unit, the learner will be able to provide security for hardware and software. This knowledge will be demonstrated through completion of the achievement indicators at the end of this unit.

## SPECIFIC OBJECTIVES

Upon completion of this unit, the reader will be able to:

1) List three major categories of hardware/software security.
2) Define external and internal security.
3) Describe five types of external security procedures and devices.
4) Describe five types of internal security procedures and devices.
5) Define operational security.
6) Describe five types of operational security procedures and devices.

# Establish Microcomputer Hardware/Software Security

BY: DR. ROBERT WATTS

Hardware and software security will vary greatly depending upon the organization, physical setting, value of equipment, importance of data, and value of the information. Although most organizations will not need the extensive preparations presented in this unit, advisory committees and microcomputer supervisors should be aware of the wide variety of potential hardware and software security problems and ways in which these problems might be addressed. A fundamental security consideration evolves from the relationship between security and cost: the more security needed, the more time and cost involved. Security can be considered in three broad categories: (1) physical security of the facility and its contents, (2) operational security, and (3) user data security and backups. The first two types of security are presented in this unit. Units D.5 and D.7 present information regarding user data security and backups.

## PHYSICAL SECURITY

Physical security can be subdivided and analyzed from the standpoint of **external security** and **internal security.** External security includes the topics of unauthorized access and controlled access to the facility. Internal security includes planning and prevention of all possible accidental or malicious events that might happen within a microcomputer facility.

Planning for external security starts with the evaluation of potential locations for the microcomputer facility. One should consider the importance of having direct access from the outside versus a room that is well inside a building. Are there windows in the room that might provide easy access to an intruder or is the proposed facility in a basement or on an upper floor? Should windows have decorative bars or electronic detection devices? Can windows be opened, even a little bit (software is small), or does it take a special key to open the window? Each of these questions should be considered before instructors make a final decision about the location of a microcomputer library.

Outside doors may need to be made of especially heavy material. Facilities which must be locked from the inside should have doors with deadlock bolts. Outside and inside doors with locks should have new heavy-duty locks or the old locks should be re-keyed. The control of keys is one of the biggest problems instructors will encounter as they attempt to balance optimum use with adequate security. A key checkout system is one aid to the control of keys (See Appendix A). A key lockbox system (similar to the system used by realtors) is another method for controlling access to keys. It is essential that security and maintenance personnel have access to keys to the microcomputer facility in case of an emergency.

More sophisticated alternatives to the traditional key system include cardkey locks which use a credit card device with a unique programmable code. More expensive systems are those which test for fingerprint and voiceprint to provide access to the authorized individual. Guards or student supervisors may be used to check identification which has the user's picture on it. An internal television system can be used to screen potential users.

Once the best location has been determined, then internal security can be considered. Instructors with responsibility for the facility can be prepared for accidental problems or acts of nature by installing automatic heat, smoke, and fire detection equipment. Fire alarms and fire extinguishers, both built-in and hand-held, should be considered by vocational teachers who are preparing the facility. Special types of extinguishers are recommended and available for computer rooms and it is essential that the correct type be acquired. Teachers involved with planning the facility should request assistance from local fire departments or other fire protection professionals. Water sensing devices are also available and especially important if the facility is to be located in a basement.

Malicious acts of vandalism have happened on college campuses as well as in industry. The potential vandal should be discouraged by the precautions of external security. However, should an individual enter the facility undetected, management should be prepared to minimize the loss.

Electronic movement detection devices attached to silent or audible alarms are replacing the guard dog. These systems can provide a microcomputer laboratory with 24 hour, 7 days a week surveillance. The facility should be designed so that the intruder can not gain total access to everything upon entering the facility. Heavy-duty locked cabinets should be used to store software, spare parts, and extra computers and peripherals. Hard disk drives and infrequently used peripherals should be placed in a separate room.

A variety of security devices are available for microcomputers and peripheral equipment. Prices range from $75.00 to $200.00 for each device. They range in style from bolts and cables to complete cabinets that secure each workstation. Another alternative for the microcomputer advisory committee to consider is the purchase of insurance which covers damage or loss of property. Vocational teachers must weigh the cost of providing security devices for the total facility against the cost of the potential loss of equipment.

Coin or token operated control systems can be used to control access to and the length of time that equipment is used. In this way, income can be generated which might provide for supplies or a sinking fund for replacement of equipment as it ages.

It is not unheard of that the frustrated microcomputer user, in the heat of creative passion, may momentarily lose control of common sense and take abusive action against anything near by. A heavy-duty table should adequately withstand pounding fists, and securing each item on the workstation will eliminate accidentally knocking a monitor or disk drive to the floor. Such behavior usually begins with muttering to one's self, followed by a more extensive personal conversation with the workstation. An alert director or student assistant can usually prevent physical damage before it happens.

**Operational Security**

Operational security primarily relates to the operation of the microcomputers, peripherals, and hard disk, and to the use of the software or file accounts. A software checkout system (See Unit D.1), access codes such as account number and user ID, or password on the hard disk will provide reasonable control so that only authorized people can use hardware and software. Increased control can be provided by using commercial software locks and data encryption devices. A tree structure or file hierarchy will provide several layers of security (see Unit D.5).

Instructors may use the microcomputers for class assignments or simulations, while the administration may use them for record keeping and budget preparation. In each case, software programs can be designed with input/edit routines that check the values being entered for consistency or to see if they are reasonable. For example, if no checks are to be printed over $5,000, it is inappropriate to enter and process an amount over $5,000. An edit routine will find such an error before it is entered into the computer. Administrators who use microcomputers extensively should look further into the rapidly growing area of electronic computer audit trails.

Software piracy may be the most difficult problem the conscientious microcomputer administrator will encounter (see Unit D.7). The computer industry has not yet solved this problem and the manager cannot expect to do so alone. A sign should be posted that clearly states the position of the institution and that copying of software is a violation of the law. Those who are caught copying should be prosecuted. The official position of the organization should be to **only use** legally acquired software.

Time stealing, the use of the institution's microcomputers for personal business, is a problem for which the advisory committee should make a policy. Some administrators believe that the personal use of microcomputers encourages students and instructors to become more knowledgeable about hardware and software. Others believe that if microcomputers are not being used for school projects, they might as well be used for something else. A contrary position regarding computer use is that the extra use of equipment should not be allowed because it may interfere with regular use or provide unnecessary wear and use up supplies.

## SUMMARY

Microcomputer hardware/software security should be considered when planning the microcomputer facility. Proper location can eliminate many problems that might appear later at another site. The more security required, the more time needed to implement the plan and the more costly it will be.

Security should be planned for and administered in three major categories: (1) physical security, including external and internal; (2) operational security; and (3) user data security (see Unit D.5).

## ACHIEVEMENT INDICATORS

1) List three major categories of hardware/software security.

2) Define external and internal security.

3) Describe five types of external security procedures and devices.

4) Describe five types of internal security procedures and devices.

5) Define operational security.

6) Describe five types of operational security procedures and devices.

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## Appendix A

MICROCOMPUTER LEARNING FACILITY

Idaho State University
Pocatello, Idaho

**Room Key Signout Sheet**

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## Unit 6

# Create Authorized Backup Copies of Microcomputer Software

### UNIT OBJECTIVE

Upon completion of this unit, the learner will be able to abide by laws and regulations governing the copying of software and follow guidelines for making legal backup copies. This knowledge will be demonstrated through completion of the achievement indicators at the end of this unit.

### SPECIFIC OBJECTIVES

Upon completion of this unit, the learner will be able to:

1) List three problems associated with making illegal software copies.
2) Describe four ways publishers deal with backup copies.
3) Design a software copy policy for a computer-based vocational program.
4) Define the four main conditions of the Federal Copyright Act and describe how these affect making backup copies of software for educational purposes.
5) Write a paragraph concerning the vocational educator's responsibility for making legal copies of software.
6) Describe what consumers may do to protect themselves from being able to backup software.

# Create Authorized Backup Copies of Microcomputer Software

### BY: DR. ROBERT WATTS

Currently, a rather heated battle is being waged among authors, publishers, lock busters, and users. This controversy is primarily over whether users may or may not copy software that has been legally purchased (Chin, 1983). Much of the disagreement is between the creators of software, or copy protectors, and the developers of software that is designed to break the code of the protected software (lock busters) so that programs can be used legally for backup purposes (Pearlman, 1983).

Copies of software acquired through unauthorized channels, such as those "borrowed" from a third party instead of being made from the owner's original, or copies made and sold to a third party, are clearly illegal. Software "swappers," who trade copies of software without exchanging money, are of particular concern to authors and publishers (Steichen, 1984). It is estimated that for every original copy of a program, there may be as many as ten illegal copies. The financial impact on the software industry is estimated to be $700 million per year (Watt, 1984).

**The Publisher's View**

Software publishers recognize the need for backup copies and are trying to accommodate users in several ways. When vocational instructors purchase software, they should check if a backup copy is provided as part of the original purchase price or review the original manual to see if backup copies of diskettes and manuals may be purchased from the publisher at a nominal cost. For example, $20.00 is a reasonable cost to pay for backup software for an original that costs over $100.00; $5.00 is a reasonable cost to pay for backup software for an original which costs under $100.00.

Some publishers merely trust consumers or believe that they cannot prevent the work of copy busters. These publishers do not place copy protection devices on their disks and hope the consumer will treat them fairly by not making unauthorized copies. The majority of publishers continue to develop more sophisticated technical methods for software security with the belief that they can maintain a six month to a year technical advantage over the lock busters (Legg, 1984).

**The School's Perspective**

Schools often need multiple copies of diskettes or need to provide for multiple users through a hard disk system. Software publishers have been slow to recognize these needs, but some are beginning to provide discounted volume prices, e.g. strategies for one-time purchases of multiple copies (Tyler, 1984). The educational community is taking the initiative in developing software copyright policy statements, but the industry is responding slowly to these unique needs. The Sarasota County, Florida, School District has developed a software copyright policy (see Appendix A) and the International Council for Computers in Education has developed and is promoting several policy statements with regard to software copyrights, licensing agreements, and network or multiple machine use (see Appendix B).

**Software Laws**

Laws presently on the books do only a fair job in helping to clean up the grey area of what is and is not legal. Sections 107 and 117 (1980 of the Copyright Act) yield the bulk of the information on this topic, for both laypersons and educators alike (Pearlman, 1983; Bell, 1983).

Section 107 of the Copyright Act clearly states that educators may make multiple copies of a copyrighted work for the purpose of teaching. However, this applies only to purchased works, and is further limited by the following four conditions:

1. The purpose and character of the use including whether such use is of a commercial nature or is for nonprofit educational purposes.
2. The nature of the copyrighted work.
3. The amount of substantiality of the portion used in relation to the copyrighted work as a whole (10% of a work).
4. The effect of the use upon the potential market for or the value of the copyrighted work.

As reported in Bell (1983), the first two items present some difficulty for educators, but the second two are of greater concern. The amount of a program that may be copied following the copyright law is 10% or fewer than 2500 words for a computer article. Obviously, if an individual is to use a computer program, he or she needs to copy it in its entirety. A part of a program is of no use. The fourth item also poses a problem because the producer will obviously suffer a financial loss if educators are allowed to copy software in an unlimited fashion. These laws are directed at protecting the creators of software, while preventing others from abusing available technology by making multiple copies of programs.

Section 117 of the copyright laws, specifically the 1980 amendment, deals with a law that speaks directly to the problem of backup copies of software. This section states that users have the right to create backup copies of their software. That is, a reserve copy may be created by the user if used for archival purposes only. Thus users may legally create a backup copy of software if it is to be held in archive. Many software companies will provide a free backup copy to users which precludes the need for users to purchase locksmith type software and subsequently create copies of their software. If the software you have "purchased" is actually a "lease," you may in fact not even be able to backup copies of the software. The distinction between leasing and buying is made on the disk itself, and is contained within the software documentation. The copyright laws regarding leased material indicate that the leasor may surely say what the leasee can and cannot do with the software. So it is entirely up to the creator of the software as to whether or not users may make backup copies of the software.

At a time when federal law about copyright protection are evolving, several states are considering legislation that would bar unauthorized duplication of software (Tyler, 1984). It is extremely important that educators participate in the development of this legislation so the unique needs of each school system and individual vocational program can be met at a reasonable yet fair cost.

The software industry is prepared to do battle against software piracy (Swartz, 1984). The courts are dealing with an increasing number of lawsuits concerning the protection of software. Large software publishers have established the Software Protection Fund to raise between $500,000 and $1 million to promote anti-piracy sentiment and develop additional protection devices (O'Connor, 1984). It is not inconceivable that these funds will also be used to support industry lawsuits against software piracy.

**Responsibilities**

Some writers believe that software vendors and retailers are primarily responsible for software piracy (Frazier, 1984). The high cost of software and the limited warranty or license agreement that users must accept upon opening the software package put the user at a disadvantage. Dean (1983) suggests a Software Consumers Bill of Rights as an alternative to the present system (see Appendix C).

Ultimately, it is the *users' responsibility* to insure that software they purchase either provides them with backup copies, or allows them to make backup and/or archive copies of the software. Vocational teachers should investigate the publisher's reputation and policies for furnishing backup copies. This practice will ensure vocational educators of having legal software backups in case original disks fail.

## ACHIEVEMENT INDICATORS

1) List three problems associated with making illegal software copies.

2) Describe four ways publishers deal with backup copies.

3) Design a software copy policy for a computer-based vocational program.

4) Define the four main conditions of the Federal Copyright Act and describe how these affect making backup copies of software for educational purposes.

5) Write a paragraph concerning the vocational educator's responsibility for making legal copies of software.

6) Describe what consumers may do to protect themselves from being unable to backup software.

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## APPENDIX A

**Sarasota County Develops Computer Software Copyright Policy**

Due to the increasing number of court cases which have ruled in favor of copyright holders over public institutions, as well as the fact that vendors of computer software are willing to negotiate reduced charges to buyers who have an endorsable policy of copyright protection, the Sarasota County School Board adopted a copyright policy last fall.

That policy, which has proven to be very effective, is printed below. Persons wishing more information about the Sarasota County copyright policy may contact: Ray Cofolla, 2418 Hatton St., Sarasota, FL 33578; 813/953-5000 or SUNCOM 522-1141; FIRN MAIL, Ray = Cofolla.

Computer Software Copyright - 3223.1

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All Sarasota County School district personnel involved in the selection and purchase of computer software and ancillary consumable materials must negotiate with prospective vendors or suppliers to gain a release, or favorable reduction, in copyright limitations before any recommendation to purchase is made. This negotiation must be documented and presented to their immediate administrative supervisor for concurrence before the purchase order is prepared.

Documentation should include responses from a vendor's management level representative and should have commitments to release stated in writing.

Software purchase recommendations for curriculum and instruction use must have the prior approval of the associate superintendent for Instructional Services or his designee(s).

Software documentation of negotiation results will be presented to the director of purchasing in the prescribed format. Variations and deviations will be reviewed by the deputy superintendent.

Computer Software Copyright - 3223.2

The Curriculum Division will develop an instructional process to assist in teaching ethical and practical issues related to computer software development and use.

District employees are to become familiar with and adhere to statutes relating to computer program and software copyrights. Specifically, the provision of P.L. 96-517, Section 7(b), which amends Section 117 of Title 7 of the United States Code to allow for making backup copies of computer programs, will be printed and given to each district employee associated with computers and computer program activity.

Authorization component:

a. that such a new copy or adaptation is created as an essential step in the utilization of the computer program in conjunction with a machine and that it is used in no other manner, or

b. that such a new copy and adaptation is for archival purposes only and that all archival copies are destroyed in the event that continued possession of the computer program should cease to be rightful.

Employees are advised of the following guidelines and are accountable for awareness and compliance.

a. When software is to be used on a disk sharing system, efforts will be made to secure this software for copying.

b. Illegal copies of copyrighted programs may not be made or used on school equipment.

c. The legal or insurance protection of the district will not be extended to employees who violate copyright laws.

d. The director of purchasing, after authorization from the associate superintendent, is designated as the only individual who may sign license agreements for software for schools in the district. (Each school using the software also will have a signature on a copy of the software agreement for local control.)

e. The principal of each school site is responsible for establishing practices which will enforce this policy at the school level. Similar rules will be established for central administrative cost centers.

# APPENDIX B

## ICCE Policy Statement on Network and Multiple Machine Software

Just as there has been shared responsibility in the development of this policy, so should there be shared responsibility for resolution of the problems inherent in providing and securing good educational software. Educators have a valid need for quality software and reasonable prices. Hardware developers and/or vendors also must share in the effort to enable educators to make maximum cost/effective use of that equipment. Software authors, developers, and vendors are entitled to a fair return on their investment.

Educators' Responsibilities

Educators need to face the legal and ethical issues involved in copyright laws and publisher license agreements and must accept the responsibility for enforcing adherence to these laws and agreements. Budget constraints do not excuse illegal use of software.

Educators should be prepared to provide software developers or their agents with a district-level approved written policy statement including as a minimum:

1. A clear requirement that copyright laws and publisher license agreements be observed;
2. A statement making teachers who use school equipment responsible for taking all reasonable precautions to prevent copying or the use of unauthorized copies on school equipment;
3. An explanation of the steps taken to prevent unauthorized copying or the use of unauthorized copies on school equipment;
4. A designation of who is authorized to sign software license agreements for the school (or district);
5. A designation at the school site level of who is responsible for enforcing the terms of the district policy and terms of licensing agreements;
6. A statement indicating teacher responsibility for educating students about the legal, ethical, and practical problems caused by illegal use of software.

Hardware Vendors' Responsibilities

Hardware vendors should assist educators in making maximum cost effective use of the hardware and help in enforcing software copyright laws and license agreements. They should as a minimum:

1. Make efforts to see that illegal copies of programs are not being distributed by their employees and agents;
2. Work cooperatively with interested software developers to provide an encryption process which avoids inflexibility, but discourages theft.

Software Developers'/Vendors' Responsibilities

Software developers and their agents can share responsibility for helping students observe copyright laws and publishers' license agreements by developing sales and pricing policies. Software developers and vendors should as a minimum:

1. Provide for all software a backup copy to be used for archival purposes, to be included with every purchase;
2. Provide for on-approval purchases to allow schools to preview the software to ensure that it meets the needs and expectations of the educational institution. Additionally, software developers are encouraged to provide regional or area centers with software for demonstration purposes. The ICCE encourages educators to develop regional centers for this purpose;
3. Work in cooperation with hardware vendors to provide an encryption process which avoids inflexibility, but discourages theft;
4. Provide for, and note in advertisements, multiple-copy pricing for school sites with several machines and recognize that multiple copies do not necessarily call for multiple documentation.
5. Provide for, and note in advertisements, network-compatible versions of software with pricing structures that recognize the extra costs of development to secure compatibility and recognize the buyer's need for only a single copy of the software.

The Board of Directors of The International Council for Computers in Education approved this policy statement, with attachments, June 5, 1983.

The committee that drafted this policy included:

Jenny Better, Director of Curriculum, Cupertino Union Elementary District.
LeRoy Finkel, San Mateo County Office of Education
Pennie Gallant, Apple Computer, Inc.
John Hazelwood/Jeffrey Armstrong, Corvus Systems, Inc.
Marion B. Kenworthy, Saratoga High School
Richard B. Monnard, Addison-Wesley Publishing Co.
Henry Vigil/Cliff Godwin, Cybertronices International
William Wagner, Santa Clara County Office of Education



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# ATTACHMENT 1

**Suggested District Policy on Software Copyright**

It is the intent of _____ to adhere to the provisions of copyright laws in the area of microcomputer programs. Though there continues to be controversy regarding interpretation of those copyright laws, the following procedures represent a sincere effort to operate legally. We recognize that computer software piracy is a major problem for the industry and that violations of computer copyright laws contribute to higher costs and greater efforts to prevent copies and/or lessen incentives for the development of good educational software. All of these results are detrimental to the development of effective educational uses of microcomputers. Therefore, in an effort to discourage violation of copyright laws and to prevent such illegal activities:

1. The ethical and practical problems caused by software piracy will be taught in all schools in the district.
2. District employees will be expected to adhere to the provisions of Public Law 96-517, Section 7(b) which amends Section 117 of Title 17 of the United States Code to allow for the making of a backup copy of computer programs. This states that ". . . it is not an infringement for the owner of a copy of a computer program to make or authorize the making of another copy or adaptation of that computer program provided:
   a. that such a new copy or adaptation is created as an essential step in the utilization of the computer program in conjunction with a machine and that it is used in no other manner, or
   b. that such a new copy and adaptation is for archival purposes only and that all archival copies are destroyed in the event that continued possession of the computer program should cease to be rightful."
3. When software is to be used on a disk sharing system, efforts will be made to secure this software from copying.
4. Illegal copies of copyrighted programs may be made or used on school equipment.
5. The legal or insurance protection of the district will not be extended to employees who violate copyright laws.
6. _____ of this school district is designated as the only individual who may sign license agreements for software for school in the district. (Each school using the software also should have a signature on a copy of the software agreement for local control.)
7. The principal of each school site is responsible for establishing practices which will enforce this policy at the school level.

# ATTACHMENT 2

**Sample Software Policy of a Community College with a Large Microcomputer Lab**

It is the policy of this college that no person shall use or cause to be used in the college's microcomputer laboratories any software which does not fall into one of the following categories:

1. It is in the public domain.
2. It is covered by a licensing agreement with the software author, authors, vendor, or developer, whichever is applicable.
3. It has been donated to the college and a written record of a bona fide purchase exists.
4. It has been purchased by the college and a record of a bona fide purchase exists.
5. It has been purchased by the user and a record of a bona fide purchase exists and can be produced by the user upon demand.
6. It is being reviewed or demonstrated by the users in order to reach a decision about possible future purchase or request for contribution or licensing.
7. It has been written or developed by _____ (college employee) for the specific purpose of being used in the _____ (college) microcomputer laboratory.

It is also the policy of the college that there be no copying of copyrighted or proprietary programs on computers belonging to the college.

Source: De Anza College, Cupertino, California.

# ATTACHMENT 3

**Suggested Format of Software Licenses**

1. Designated on a per site, district-wide, or other geographic basis.
2. Requires the signature of a responsible school employee.
3. Includes provisions for a single copy purchase (with archival backup copy) at full price.
4. Multiple machine pricing: Includes provisions for a quantity discount for subsequent purchases of the same software provided:
    a. the purchase discount applies to a single purchase order.
    b. the purchase discount is noncumulative.
    c. the software is for the same computer type.

    i.e.: Radio Shack presently offers a 50% discount for purchases of 10 or more sets of the same software; Gregg/McGraw-Hill offers a discount schedule with incremental increases—buy 2, but pay 10% less; 3, 20% less; 4, 30% less; 5 or more, 40% less.
5. Network Pricing:
    May be offered as per school site or with quantity discount for school districts with multiple sites.
    * flat fee provision is preferred over any variable rate based on number of computers or number of student users.
    * network-compatibility, not just an unlocked version of the software, is required to eliminate the need for local reprogramming of copyrighted and licensed software.

Include provisions for purchase of multiple copies of documentation and accompanying materials.
i.e.: A flat fee of two times the single copy retail price is offered to network users to Random House software.

# ATTACHMENT 4

**Some Technical Notes on Software Encryption for Software/Hardware Vendors**

1. Single Machine Encryption

Explanation:

The purchased disk is not copiable by ordinary means. The software cannot be transferred to a network system or used on several computers at once. This scheme is the most common, especially for inexpensive software.

Technical notes:

The protected disk is usually formatted in a non-standard way which will defeat standard disk copy programs such as COPYA on the Apple or TRSDOS BACKUP on the TRS-80. Alternatively, the publisher may write special information on the disk in places which the standard disk copy programs do not check. The copy program proceeds to completion, but the special information is not transferred to the duplicate disk. When the duplicate is used, the software checks for the special information, fails to find it, and stops.

Implications:

Schools will need to purchase many copies of the same program and should expect significant volume discounts. The customer is entitled to an archival backup and should expect the publisher to include a backup disk with every purchase.

Manufacturers of network systems should recognize that single machine encryption (which is incompatible with their products) will remain the software industry standard unless they actively support software protection on their systems.

2. Single Site Encryption

Explanation:

A single product can serve all the machines at a site. This scheme applies to VisiCalc and LOGO.

Technical Notes:

Software which loads initially into memory and subsequently interact only with data disks is de facto "single site encrypted," even though the program disk may be uncopiable. A single program disk can be used to initialize all

the computers in a room, after which each user operates with his or her own data disks. VisiCalc and LOGO operate in this way.

A functionally equivalent alternative is referred to as "master and slave" or "lock and key" encryption. This scheme is common where a program is too large to fit in memory all at once. Frequent disk access is needed as different parts of the software are brought into play.

In the "lock and key" scheme, the program modules which are routinely needed can be freely copied. A "slave" disk containing these modules is duplicated for each computer (or even for each student). The slave will not operate, however, unless the computer has been cold started with the (uncopiable) master disk.

Implications:

Since the "master" disk is uncopiable, the publisher still bears the burden of providing an archival backup. The protection on the "master" disk normally makes the software incompatible with network systems, so the above comments again apply.

Single site encryption reduces the dependence on volume discounts to facilitate multiple machine use. However, volume discounts should still be made available at the district level to encourage district level adoption of software.

3. Hard Disk/Network Compatible Versions of Software

Explanation:

Floppy disks containing network compatible software must be copiable since the software is copied as it is transferred into the network. The problem of protecting network compatible software is how to allow this legitimate copying while preventing illegal copying. One solution is to abandon software protection altogether and to rely on license agreements to prevent illegal use of the program(s). The problem with this solution is that freely copiable software may be freely copied.

Other solutions rely on publishing special versions of the software for the various network systems available. These versions do not run on stand-alone computers.

A publisher can also take steps to discourage people from installing the network software at sites other than the intended site.

Technical Notes:

A publisher can prevent network software from running on a stand-alone computer by using a device check. The software senses whether it is running on a network system and stops if it is not The device check is specific to the network system involved. Software with a device check could be installed at many network sites, not just one for which it was licensed.

To discourage use at non-licensed sites, the publisher can embed the name of the licensee in the software. This requires that the publisher customize each network-compatible version sold. Although such customization discourages transporting the software to another network site, it does not physically prevent it.

To prevent posting of the software to another network, the publisher might implement what is essentially single machine encryption on the network level. This protection scheme would work by checking the serial number or other unique identifier in the network hardware. If the software encountered a change in identifier, it would fail to operate. This has the disadvantages that a licensee would have to be a single network installation and that normal activities such as replacing or upgrading one's network system would disable the software.

Implications:

Use of a device check or serial number check requires a publisher to maintain a separate inventory item for each device to be supported. The time required for a publisher to embed the customer's name in each product sold for use on networks can become prohibitive. These protection schemes may prove economically unfeasible for inexpensive software.

These protection schemes require close working relationships and sharing of information between publishers and network system manufacturers.

# APPENDIX C

### A Software Consumer's Bill of Rights

A few years ago the only people you saw buying software in computer stores were engineers and whiz kids. Well, I want to let you know we made a big mistake. If only a few of us had been willing to muscle our way in then, we wouldn't be faced with the mess we have now—programs that are so complicated you need a 400-page manual

to figure them out; 400-page manuals that are so complicated you need to buy tutorials to figure them out; and tutorials that are so full of jargon and tech-talk that you have to be an MIT professor to figure them out.

Software companies aren't dumb. They know that the products they are selling us today were created for an entirely different audience. And they've come up with a solution: "User-Friendly" software. The only problem is that they didn't change their products—only the way they described them. So we still need manuals, and tutorials. And we still need to enroll in eight week classes just to learn how to type a letter on a computer.

Enough! It's our turn now. We've been convinced that computers can make our work easier and we're waiting for software that will keep this promise. We use our computers to increase profit—not to play games or as a hobby. We may be late getting started, but that doesn't mean we should pay large sums of money f or programs that take longer to use and are more frustrating than the typewriters and calculators they are supposed to replace . . . it's time for a Software Consumer's Bill of Rights:

I. You shall have the right to be spoken to in your native language. Bits, bytes, bauds, RAMS, and ROMS are not words you should have to learn in order to produce a monthly sales report. "Boot the DOS" is not a helpful instruction. You shouldn't need a technical dictionary to read a screen display. If software manufacturers want to sell programs only to engineers and computer scientists, they may continue to use this jargon. If they want to sell to us, they must learn to speak English.

II. You shall have the right to be told exactly how a program will save your business money. If you don't ask—don't complain later. If you do ask and can't get an answer that makes sense to you, keep shopping. While you're at it, you might as well find out whether the software can adjust to your way of doing business. There are a lot of programs out there and one might be just perfect for you.

III. You shall not be required to hire a teenage consultant to learn how to use a program. Since manuals are unreadable, impractical, and get lost, they should not be depended upon for teaching you how to use a program. If the software can't teach you directly on the computer screen, don't buy it.

IV. You shall be provided with a single source of information describing the relative merits of each program available for the application you need. If you want to buy a car or a stereo you probably do one of two things: you ask people you know for their recommendations, or you look at an issue of *Consumer's Reports*. What you don't do is rely solely on the work of a salesperson. Individual reviews or massive directories don't tell us what we need to know: which product is uniquely qualified for the job we need it to do.

V. You shall have the right to expect your software not to bomb, crash, or give up and play dead. Software manufacturers know that it is quite impossible for anyone to tell in advance whether their disk will have enough room to store a new program. So why is it that they don't let us change disks when we run out of space? Why don't they warn us in advance? What they do instead is print scary messages like "Fatal Error Disk Full," "BDOS Error," "Disk Overflow," and even worse, they mean it! There's no excuse for this kind of behavior—for the inconvenience it causes us.

VI. You shall be given the respect and consideration due a competent adult from the moment you walk into a computer store until the last day you use a product. When you left home you expected your days of dependency to be over. Now you decide to buy a computer and some software. The salesperson says, "Trust me, I know what you need," and then says, "Watch this—you'll be amazed." You leave the store without touching the keyboard (he made it look so simple!) and go home to read the manual. If you are lucky enough to be able to understand half the words on the page, you'll probably have to cut through Dick and Jane material like "Now, that wasn't so bad was it?" Of course, you have to call the Hot Line (if there is one) or the dealer (if there isn't) because nothing ever seems to work the way the manual says it will. And because you're the 40th caller today with that same question, you're likely to receive a mechanical, if not impatient and condescending reply. Even if the answer you get is correct, you're left feeling apologetic and incompetent. They should be apologizing to you.

VII. You shall have the right to use software before you buy it. One of the most effective marketing tools software manufacturers have come up with to date is the "self-running demo." These impressive programs show the cursor zipping through screen after screen and are punctuated by self-congratulatory remarks such as "Look how easy it is to enter dates!" and "All the data entered—project complete!" What they don't announce is that it took 200 man-hours to program that show, and it will probably take you as long to come up with the same results. Before you invest that kind of time, insist on running the program yourself. And don't let the salesperson near that keyboard!

VIII. You shall be able to get a new program running on your computer before your coffee gets cold. Have you seen some of the "Install/Configuration" preliminaries you have to go through to see software today? Unless you have a couple of hours you might as well forget it because these tasks must be done in one sitting. Stop, or get

interrupted, and you'll have to start from scratch. If you make one mistake you don't have to worry—until you finally begin to use the program. Then you get to go through the whole process again.

IX. You shall have the right to expect software manufacturers to provide program updates for free or at a nominal charge. Programming technique and hardware technology are improving every day. This means that the software you buy tomorrow should be faster and easier to use than the software you buy today. So does this mean you should have to buy a new program every year? Some manufacturers think so. Suffering their archaic versions and underwriting their R & D efforts should be enough to win you a place on their Most Valued Customer List. The most you should have to pay for an update is the cost of manufacturing the new disk.

X. You shall have the right to live a full life apart from the time you spend at your computer. The only consideration I can draw from the way some software packages operate is that their designer really thinks that you will be happy spending nights and weekends figuring out how to make their product work for you—or reconstructing your records when it doesn't. If putting your business on a computer can't give you long lunches and lengthy vacations, at least it shouldn't force you to work harder than you did before.

Martin L. Dean

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